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ABSTRACT

Past investments in the U.S. work force--early childhood interventions, formal education, and training--have improved productivity and made important contributions both to the wages of individuals and to the growth of the economy. Excellent, comprehensive prenatal care, good nutrition, medical care, and intensive early childhood education programs would provide at-risk children with the resources needed to increase their chance to reach their full potential. Too often, society fails to provide these preventive programs and supportive services and must undertake more expensive and less effective corrective actions. Formal education has made a major contribution to U.S. economic performance and productivity growth. Educated workers are more skilled and can do their jobs more effectively. This leads to better job performance and higher earnings for individuals and to higher productivity and economic growth for society. Higher earnings may reflect other factors, however, such as family background, innate ability, and employer hiring preferences. Education is also a source of technological change and innovation. Employer-provided training has the largest effect in increasing earnings--larger than vocational and technical institutes or other forms of off-the-job training. Employer-provided training also reduces turnover and unemployment. If U.S. firms are to be organized as high performance work organizations, women and minorities, who will be the majority of new entrants to the labor force, must be guaranteed access to training. (Contains 230 references.) (YLB)

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INVESTMENT 21

Investment in Learning:

An Assessment of the Economic Return

By

M. Edith Rasell
Eileen Appelbaum
Economic Policy Institute

U.S. DEPARTMENT OF EDUCATION
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Investment in Learning:

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December 1992

INTRODUCTION TO INVESTMENT 21

In 1990, a group representing association leaders in elementary, secondary, and higher education began meeting in Washington, D.C. to examine investment in learning in the United States. We focused on "investment" to signify our interest in a serious analysis of the economic returns to the nation from a conscious strategy to develop its human talent. By "learning" we were principally, but not exclusively, concerned with support for education and training from pre-school through postdoctoral study. But our interest extends as well to corporate investment in employee training and to child development efforts such as prenatal care, adequate nutrition, and health services.

What we learned concerns us deeply, and we believe it will concern you as well. Exploring the statistics on nationwide support for education and training, we came to understand that recent claims that the United States is devoting a larger and larger share of its resources to educating the next generation are wrong. The share of national income devoted to developing the skills and talents of our people has declined in the past twenty years. On this front, the United States is not moving forward, but in reverse at the time the international challenge to compete with a well prepared work force has increased.

We believe that a powerful campaign to analyze, document and advocate investment in learning as the foundation for the nation's success in a new century is essential. We call that campaign Investment 21 and organized ourselves as the steering group for the effort.

Our first task has been to request the Economic Policy Institute (EPI) to prepare two papers with support provided by our organizations. The first paper, Investment in Learning: An Assessment of the Economic Returns, written by M. Edith Rasell and Eileen Appelbaum is the most comprehensive summary now available on findings of significant studies on the returns to investment in early childhood education and services, formal education from elementary through collegiate, and employee training.

The second paper is a powerful statement by Jeff Faux, President of EPI, on Economic Competitiveness and the Human Capital Investment Gap. This paper stakes out an overall case for understanding the trend and status of investment in learning for the United States. We are publishing this in a companion volume.

Our nation is at a critical point of nationwide decision making on what form and extent of investments will best develop our nation's economic, social, cultural and civic strength. These Investment 21 papers inform that decision making. They are presented in this no-frills format to encourage a deeper, richer analysis of essential investment choices for our nation.

All rights to these papers are held by Investment 21 and the Economic Policy Institute and they may be reproduced in part or in whole with the permission of Investment 21 or EPI. Inquiries should be addressed to Investment 21.

We welcome reactions to the papers. These papers are the beginning of a long term project to analyze and advocate the learning needs and the investment needed for learning in our nation.

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EXECUTIVE SUMMARY: EDUCATION, TRAINING, AND LABOR SKILLS

The U.S. economy is at an important crossroads as it undertakes to meet the challenges of a world in which both technological change and competitive pressures are rapidly accelerating. The blue-ribbon Commission on the Skills of the American Workforce addressed this issue squarely in its report, *America's Choice: High Skills or Low Wages!* The choice is clear: reorganize our factories and service firms into high performance work organizations that use trained and educated workers to produce the better quality goods and services that customers want and that can be sold at high enough margins to support middle class incomes for American workers, or watch living standards erode as American companies try to compete on the basis of lower wages.

Whether intended or not, the U.S. has been implicitly following the low wage path for nearly two decades. This is the reality behind the growth of part-time and contingent work arrangements, underinvestment in education and training, underinvestment in public and private capital, the long term growth of imports, and the decline in real wages. U.S. businesses have failed to face up to the fact that meeting the challenges posed by the shift to process technologies based on microprocessors and the increased competition in product markets requires a fundamental reorganization of the workplace. The recent report of the Secretary of Labor's Commission on the Achievement of Necessary Skills (the SCANS report) noted that "[n]ine out of ten employers are operating on yesterday's workplace assumptions." Other recent studies confirm this finding.

Investments in the education and training of workers can have their greatest impact if U.S. firms choose to compete in today's world economy on the basis of high performance and efficiency. The disappointing observation of the *America's Choice* report, that only 5 to 10 percent of American businesses were pursuing workplace innovations that would make them high performance work systems, is reflected in the report's finding that there is an "absence of an obvious skills gap" and a "lack of any expectation among the majority of employers that their skill requirements will be changing."

It is not in relation to current workplace practices, however, that the alarm over the quality of the U.S. workforce must be sounded, but in relation to the workplace requirements of an economy following a high wage, high performance growth path. Education, training and skill development cannot be separated from whether, and how, worker skills are utilized by employers. Reorganizing work to move problem-solving and decision-making down the organization to front-line workers will require a workforce with the broad skills and training to perform successfully in this new environment.

As this report documents, past investments in the U.S. workforce--early childhood interventions, formal education, and training--have improved productivity and made important contributions both to the wages of individuals who have been the recipients of these investments and to the growth of the U.S. economy. Such investments are likely to be even more important in the future as the U.S. attempts to move to a high performance growth path. Failure to make these investments today seriously jeopardizes the ability of the U.S. to make this important adjustment, and may trap the U.S. economy in a "low skills equilibrium." The result will be a further erosion of the competitiveness of U.S. firms in world markets, and a further decline in American living standards. A well-trained and educated workforce is essential if the U.S. is to make the transition to a high skills economy and adjust successfully to the new conditions of economic competition.

Learning has played a crucial role in U.S. economic development. We can more fully understand and quantify the economic value that education and training contribute to prosperity by examining past effects on the living standards of individuals and the growth of the economy. This white paper provides a rigorous review and assessment of the evidence of the economic benefits of investments in learning, and the economic costs of failing to make these investments. Our examination focuses on three areas: readiness to learn, formal education, and training.

READINESS TO LEARN

In order to take full advantage of schooling, children need to start kindergarten and first grade ready to learn. Preparation for learning begins at the time of conception. Access to high quality, comprehensive prenatal care for mothers is essential to ensure that babies are born healthy. Among industrialized countries, the U.S. has the highest rate of infant deaths within the first year of life, largely because too many women receive inadequate prenatal care. The high cost of caring for these sick newborns--estimated at $2.4-3.3 billion in 1985--could be reduced and much of the illness prevented with universal comprehensive prenatal care. The savings for every dollar spent on high-risk pregnant women is between $2 and $3.30 just in the first year. The Special Supplemental Food Program for Women, Infants and Children (WIC), which provides nutritious food to low-income pregnant women, infants and children also yields savings of $2-3 in reduced medical costs for mothers and babies for every dollar spent.

Early childhood education programs are particularly important for readying disadvantaged children for school. But Head Start, the federally funded program for low income children, serves only 30 percent of those eligible due to inadequate funding. For every dollar spent, $2.48 is saved through reduced use of special education services, lower dropout rates, lower use of welfare services, reductions in teen pregnancies, fewer arrests, and higher rates of employment.

Health care is inadequate for many children. In the U.S., the rate of immunization against the common childhood diseases is among the lowest in the western hemisphere, and has been worsening in recent years. Vaccination is much cheaper than treating these children once they get sick. Lead poisoning can cause both physical and mental disabilities. An estimated 3.75 million children have blood lead levels that could cause problems, but there is no comprehensive, nationwide effort to monitor lead levels in children and little money for treatment or prevention. Lead screening and treatment is less expensive than placing these children in special education classes and giving them assistance later in life when their disabilities reduce their capacity to work. These economic calculations ignore the human toll of illness and disability, and the wasted talents which we, as a nation, cannot afford to lose.

FORMAL EDUCATION

Formal education--including primary and secondary school, and post-secondary education--has made a major contribution to U.S. economic performance and productivity growth. Education makes workers more productive; on average, better educated workers are more skilled and can do their jobs more effectively. This leads to better job performance and higher earnings for individuals, and to higher productivity and economic growth for society. By preparing scientists and engineers, education also contributes to the pace of technological change through research and development efforts into new technologies, products, and processes.

The higher earnings of more educated workers may reflect factors in addition to the higher productivity or advanced skills that result from increased schooling. Such factors as family background, innate ability and employer hiring preferences also affect wage levels. But even after taking these influences into account, studies show that education enhances productivity and raises wages.

Job performance improves with rising intellectual achievement. General verbal and mathematical abilities are used everyday in most jobs, even those generally thought of as nonintellectual and consisting predominantly of manual labor, although the importance of cognitive ability is greater for jobs of relatively higher complexity. Years of experience or learning on the job do not offset initial differences in cognitive ability. There is no substitute for basic skills or for advanced educational achievement. Additionally, training is easier to do and more successful among workers with more education and higher cognitive ability.

Earnings generally rise with increases in the quality or quantity of schooling, although some workers may receive higher wages for reasons unrelated to productivity advantages or special skills. Particularly in jobs available to high school graduates, better job performance and higher productivity does not necessarily translate into higher wages. Earnings are determined by a combination of factors including skill and productivity levels, discrimination, and industry and regional variables. Ignoring any of these effects could overstate the benefits of education. But after all other influences on wages are considered, schooling does increase skill, improve workers' productivity and raise wages. After adjusting for other factors which could affect wages, each additional year of schooling is estimated to increase earnings by five to seven percent. As years of schooling increase, wages and lifetime earnings rise, unemployment falls and work lives lengthen.

When the effects of education on earnings are separated from the effects of intelligence, the contribution of native intelligence is quite small. Only about 10 percent of the increases in wages associated with higher educational levels are actually due to differences in intelligence. And childhood IQ has little influence compared to adult educational achievement. It is learning, not aptitude at a young age or intelligence, that is the important factor in determining wages.

Education and cognitive ability are particularly important when technology is changing rapidly. In industries with high productivity growth that are rapidly introducing new technology there is an increased need for more educated workers. These industries pay higher wages for educated workers than do less innovative industries employing workers with similar skills, and wages rise more rapidly.

The quality of schooling, as well as its amount, affects earnings. Students who attend higher quality public primary and secondary schools--indicated by lower pupil-teacher ratios, relatively higher pay for teachers, and longer length of the school year--earn higher wages. Students attending higher quality primary and secondary schools are more likely to finish high school and continue into post-secondary education than are students attending lower quality schools. In recent years, improvements in the quality of blacks' education have narrowed the black-white earnings gap. Quality improvements can also raise achievement.

College and university education is particularly beneficial for both individuals and society. Undergraduate education has a greater effect on earnings than does secondary schooling, and also a greater effect than graduate school. A high school diploma raises earnings by 15 to 25 percent over the earnings level of an eighth grade graduate, and a college degree raises earnings by 18 to 47 percent above those of a high school graduate.

An individual's lifetime rate of return from an investment in university or college education averages 10 percent. This means that for an investment alternative to be more profitable, the tuition, expenses and foregone wages which are the cost of a college education would have to be invested and earn an annually compounded return for 30 to 40 years that was greater than 10 percent. Such investments are hard to find; higher education is one of the most profitable investments individuals can make. Society also benefits because higher earners pay higher taxes, and educated people are more likely to contribute to the growth in knowledge, and develop new products or production methods.

During the past ten years, there has been a rapid increase in the wages earned by college-educated workers relative to high school graduates. The labor market is signalling a demand for college-educated workers that is going unfulfilled. We need to increase the share of the workforce with a college degree from its current level of 25 percent to about 30 percent. To do so would require a major expansion of higher education enrollment and completion rates. At a minimum, college graduation rates must continue at their current level despite tuition increases and the cutbacks in public support for higher education due to ongoing state budget crises. But we must also expand college enrollment and completion. This requires that a growing percentage of our high school graduates must be academically qualified for and financially able to pursue higher education.

The Chapter 1 program provides money to states and school districts for the special educational needs of disadvantaged, migrant, neglected, and delinquent children. The National Assessment of Educational Progress (NAEP), a test which gathers nationally representative achievement data, shows that low-achieving students, students from disadvantaged urban communities, and minority students (all groups with a large share of Chapter 1 participants), have been improving in math and reading much more rapidly than has the student population as a whole. Achievement has been rising much more among low achievers than among high achievers, and in disadvantaged urban communities more than in advantaged communities. Blacks and Hispanics are closing the gap with whites. Much of this progress is due to the Chapter 1 program. Children who receive Chapter 1 services score higher on achievement tests than do similar students who do not participate.

For the individual, education improves job performance, raises productivity and boosts wages. In the aggregate, this means that education improves national economic growth and spurs productivity increases. In addition, education facilitates and promotes technological change, a very important component of economic growth.

A major investigator of the determinants of economic growth is Edward Denison of the Brookings Institution. Denison has found that between 1929 and 1982, a time during which production techniques improved radically and mechanization became essentially universal, increases in educational attainment were responsible nonetheless for over 27 percent of all growth in output per worker. Another technique of analysis examines growth in the economy as a whole. Over recent decades, most growth has been due to a growing population and enlarging labor force, and increases in plant and equipment. But education still contributed 7 percent of the total.

That the education and achievement level of the workforce is important for economic growth is further supported by work which has attempted to explain different economic growth rates among countries. Analyses which omit consideration of workers' skills and intellectual abilities do a much poorer job of explaining differences in growth than do analyses which include these factors. Differences in the abilities of the labor forces of various countries contribute to differential rates of growth.

Education makes still another important contribution to economic performance. In addition to being a factor which improves workers' skills, it is also a source of technological change and innovation. Although the impact of education on the growth of knowledge and improvements in technology is impossible to quantify precisely, studies by Denison and others suggest it is very large. This benefit of education is not included in the estimates of the gains from education described above, and if it could have been included, the measured benefits of education to the economy would be much greater.

TRAINING

In a changing economic environment, training plays an important role in maintaining the competitiveness of the economic system and in improving individual job performance as measured by productivity, wages, job tenure, and turnover. Lack of training or inadequate training may also be part of a larger problem that locks the economy into a low-skill employment trajectory. A modern economy that continues to organize work in outmoded ways may find itself caught in a situation in which the lack of investment in training and lack of demand for skilled workers are self-reinforcing. Some observers are concerned that the U.S. is in danger of falling into such a trap.

Comparisons with our main international competitors suggest that the competitiveness of the U.S. economy and its ability to provide high wages for U.S. workers depend on a shift by U.S. companies to new job and organizational design practices and on the investments we make as a nation in a well-qualified labor force. A consensus is emerging that the future strength of the U.S. economy is inextricably linked to the education and training we provide to the 70 percent of the U.S. labor force that does not go to college. International comparative studies consistently show that U.S. firms invest less in training and perform more poorly than do businesses in other nations.

Training raises workers' productivity and improves skills. More highly trained workers produce higher quality products and greater volumes of output, and require less supervision. In new plants, start-up time is reduced and operating improvements are greater among well-trained workers.

Workers' wages grow more quickly when they receive training, particularly employer-provided training, with the exact magnitude of the increase ranging from 5 to 10 percent depending on the workers and on the type and intensity of training. Wages rise because workers' productivity is enhanced. By raising wages, training increases the attachment of workers to the firm and reduces turnover, thereby lowering the incidence of unemployment among the workers who received training.

In 1990, only 12 percent of all workers in the U.S. received enterprise-related training. In Sweden, Japan, and Australia, participation rates were two to three times higher. In West Germany and France very high proportions of *young people* participated in such training -- 76 percent of fifteen- to nineteen-year-olds in West Germany and 43 percent in France. In comparison, only about 3 percent of noncollege-bound youths enter an apprenticeship in the U.S. and only 4 percent of young workers who are not university graduates get formal training at work. In 1984, German employers spent more than twice as much on worker training as did American firms -- $633 per worker compared with $263.

As firm-based training is currently administered in the U.S., employers have sole responsibility for selection of the training participants and for administration of the programs. One result is that front-line workers receive much less than their proportionate share of training. Fully 58 percent of employer-provided training goes to workers in executive, managerial, professional, and technical positions. However, these workers account for only 27 percent of employees. Similarly, race and gender appear to be important determinants of who receives such training. White males are disproportionately likely to be selected to participate. This is troublesome, since women and minorities will comprise two-thirds of new entrants to the labor force between now and the year 2000.

CONCLUSION

A well-educated and highly trained labor force is a prerequisite for a high performance, high wage economy able to meet the challenges of increasingly competitive world markets. Education has made significant contributions to U.S. economic growth and prosperity in the past, and its importance in the future will be even greater. Money spent wisely getting children ready for school and on education and training programs brings future financial benefits for individuals and for society. Enhancing future returns by raising worker productivity through additional education and training is an important reason to increase the U.S. investment in learning.

Investments in the physical, mental and emotional health of children, in the education and training of young people, and in life-time learning return large financial gains. But as with most investments, the returns do not appear immediately. We must adopt a long term view and be patient. In a global economy, U.S. performance lies in the skills and creative abilities of our workforce. We cannot afford to waste the talents of anyone. Investing in our nation's human resources is a necessary first step in building a competitive, high performance economy for the 21st century.

INTRODUCTION

A well-educated labor force is a prerequisite for the high performance, high wage, competitive economy we desire for the U.S. In today's world of global competition with the revolution in information technology and an increased need for flexible workers, the importance of education in promoting national economic well-being has never been greater. But we are also in an era of tight budgets when many needs are vying with education for limited funds. Those concerned with education, with children, and with the quality of the labor force must be prepared to clearly articulate the importance of education and human resource development as a vital part of our nation's investment in the future. This paper provides a rigorous review and assessment of the evidence of the economic benefits of investments in learning, and the economic costs of failing to make these investments.

Our definition of investments in learning is a broad one, encompassing the spectrum of human resource development from conception through entry into kindergarten, the formal education system (kindergarten, primary and secondary school, and higher education), and training for both new entrants and for incumbent workers who need retraining or an expansion of their skills.

The evidence is overwhelming that investments in learning pay off dramatically by raising individual earnings, by increasing national economic growth, and by lowering the need for and the costs of remedial services. Early interventions, such as prenatal care or early childhood education for the disadvantaged, enable children to do their best and reach their full potential. But these preventive programs are only partly successful at aiding disadvantaged and high-risk families, due to inadequate funding and other barriers to access.

Further, investments in schooling and job training, like early childhood investments, also benefit the individual and society. Schooling and training improve job performance, raise worker productivity and earnings, aid technological innovation, and promote economic growth. Workers with higher levels of schooling (or better quality schooling) and training learn new skills faster, have improved on-the-job performance, and adapt more easily to new technologies. In the rapidly changing workplace, the ability to learn new skills is key to America's capacity to compete in the global market.

Investments in learning and in human resources have large and far-reaching returns. For example:

- preventive, prenatal care costs forty to one-hundred times less per life saved than does neonatal intensive care to treat sick newborns (Joyce et al., 1988);
- Head Start participation for pre-kindergarten children can return up to $2.48 for every dollar invested (Schweinhart and Weikart, cited in Lazar and Darlington, 1982);
- each additional year of school raises earnings by 5 to 7 percent (Bishop, 1991; Card and Krueger, 1990; Burtless, 1990);

- between 1929 and 1982, increases in education were responsible for over 27 percent of all growth of output per worker (Denison, 1985);

- training young workers increases firm productivity even after correcting for the high turnover rate of this population since productivity after training increases four to five times faster than compensation during a worker's first two years on the job (Bishop, 1988c; Mincer, 1989);

- training raises hourly wages and reduces turnover and unemployment (Mincer, 1989).

Yet, despite evidence such as this, the federal government continues to inadequately fund education and preventive programs and U.S. firms invest only 1.4 percent of their payroll in formal training programs, a fraction of the investment made by their counterparts in other industrialized nations. This failure to invest in learning is one component of a larger set of misguided policies that locks the economy into a low-skill employment trajectory.

A consensus is emerging that the future strength of the U.S. economy is inextricably linked to the education and training of the current and future labor force. By failing to make needed human resource investments in learning, the U.S. is committing itself to a downward spiral in wages and living standards. Our alternative is to make the needed investments and to catch up with our competitors who have steadily been making the expenditures necessary to carry them into the 21st century.

SECTION I: READINESS TO LEARN

INTRODUCTION

The early years of life -- even starting from the time of conception -- are perhaps the most important for ensuring that a child will develop to her full potential as a contributing member of society. Enabling factors of fundamental importance to this process include: women's access to excellent prenatal care and good nutrition during pregnancy; children's access to preventive and acute health care services including immunizations and lead screening along with sufficient caloric and nutritional intake; and, children's access to a stimulating intellectual and nurturing emotional environment. But many children in this country lack these basic necessities. Thus, children are born and grow up under conditions which stunt their physical, mental, and emotional development. As adults, these children may function less well and require more social support than would have been the case had their early years been more supportive. We often provide costly corrective and supplementary services once it is clear a child, youth, or adult is in trouble, but we too often neglect the less expensive preventive programs that would make these later interventions less necessary. By failing to invest in relatively inexpensive preventive services, we end up paying far more in later years to offset the lack of early interventions.

PRENATAL CARE

Infants and children are more likely to become healthy and productive members of society if they are born to a mother who is well and who had a healthy pregnancy. However, in the U.S., too many babies are born without this basic advantage and have a reduced chance of a healthy and productive life. In 1989, ten out of every one-thousand infants died before their first birthday, a rate higher than in 18 other countries including Spain, Singapore, and East Germany (see Table 1, page 10). The rate for blacks, 17.6 deaths per 1,000 births, is over twice the rate for whites, and above the rate in thirty-two other countries.

The major cause of this early mortality is inadequate fetal growth before birth, manifested by low birth weight, defined to be a weight at birth below five and one-half pounds (2,500 grams). Most commonly, low birth weight is the result of preterm labor and delivery prior to thirty-seven weeks of gestation. (A normal, full-term pregnancy is forty weeks of gestation, on average.) Not only is low birth weight associated with elevated mortality, but it also may cause health problems and developmental abnormalities in children, and it imposes a financial and emotional burden on families and society. Very small or ill newborns receive highly intensive, technologically advanced care, which is also very expensive. The incidence of low birth weight births in the U.S., one in every fourteen newborns, is higher than in most other developed countries (see Table 2, page 11), and since 1984 has been *rising.*

Preventing low birth weight births should be a high priority in the U.S., both on humanitarian and economic grounds. One intervention which repeatedly has been shown to reduce the incidence of low birth weight births is good prenatal care begun early in pregnancy (Showstack et al., 1984; Gortmaker, 1979; Eisner et al., 1979; OTA,1987; Quick et al., 1981).

TABLE 1
Infant Mortality Rate[a], 1989

Rank	Nation	Rate	Rank	Nation	Rate
1	Japan	4	17	Spain	9
2	Finland	6	19	Belgium	10
2	Sweden	6	19	Israel	10
4	Canada	7	19	Italy	10
4	Hong Kong	7	19	New Zealand	10
4	Netherlands	7	**19**	**United States**	**10**
4	Switzerland	7	24	Cuba	11
8	Australia	8	24	Czechoslovakia	11
8	Austria	8	24	Greece	11
8	Denmark	8	27	Portugal	13
8	East Germany	8	28	Bulgaria	14
8	France	8	29	Trinidad & Tobago	15
8	Norway	8	30	Hungary	16
8	Singapore	8	30	Jamaica	16
8	United Kingdom	8	30	Poland	16
8	West Germany	8	33	Kuwait	17
17	Ireland	9	34	Costa Rica	18

[a] Deaths within the first year of life per 1,000 live births.

Source: Children's Defense Fund. *The State of America's Children 1991.* Washington, DC, 1991.

Prenatal care is beneficial for all pregnant women, but is of greatest help to women who are at highest risk for low birth weight births. There are many reasons why a baby might be born with a low birth weight, but certain risk factors are often present. These include demographic characteristics of the mother such as low socioeconomic status, low educational attainment, and age below seventeen; and medical factors such as inadequate prenatal care, anemia or poor nutritional status, and substance abuse including smoking. Infants may be born with low birth weight in the absence of these factors, but these are the most commonly associated conditions. Because these risk factors are more prevalent among blacks and Hispanics than among whites, in 1988 low birth weight births (weights below five and one-half pounds or 2,500 grams) were two and one-third times more frequent among black women than among white women, and very low birth weight births (weights below three and one-third pounds or 1,500 grams) were three times more frequent. As the level of prenatal care increases, improvements in outcomes -- reduced incidence of low birth weight and fewer preterm pregnancies -- are greatest among disadvantaged women (Greenberg, 1983; Murray, 1988; Ryan et al., 1980).

Routine prenatal care lowers the risk of low birth weight births, and more comprehensive care -- which includes such additional factors as case management, nutrition counselling, instruction in recognizing preterm labor, and other social and medical

TABLE 2
Percentage of Very Low Birth Weight (VLBW) and Low Birth Weight (LBW) Live Births in Selected Developed Countries, 1980

Country	VLBW[a]	LBW[b]
Austria	0.80	5.68
Canada[c]	0.84	6.10
Denmark	0.72	6.00
Federal Republic of Germany	0.71	5.51
German Democratic Republic	0.55[d]	6.19
Israel	0.99	7.16
Italy	0.83	6.71
Japan	0.39	5.18
New Zealand	0.65	5.27
Norway	0.59	3.25
Sweden[e]	0.49	4.03
Switzerland	0.49	5.14
United Kingdom		
England and Wales	0.77	6.79
Scotland	0.96	6.73
United States	**1.15**	**6.84**

[a] Three and one-third pounds (1,500 grams) or less. May underestimate the extent of the problem if infants weighing less than one and one-tenth pounds (500 grams) are excluded.
[b] Five and one-half pounds (2,500 grams) or less.
[c] Data for 1979.
[d] Probably an underestimate due to a nonstandard definition of live births and late fetal deaths.
[e] Data for 1978.

Source: Committee to Study the Prevention of Low Birth Weight. Division of Health Promotion and Disease Prevention. Institute of Medicine. *Preventing Low*

components -- produces better outcomes than does standard care. These differences are particularly great for high-risk women or for women who begin care late in pregnancy (Peoples and Siegel, 1983; Moore et al; 1986). Among disadvantaged women with similar risk factors, those in a comprehensive program are from 16 to 50 percent less likely to have a low birth weight baby, and preterm deliveries are reduced 25 percent compared to women receiving routine care (Buescher et al., 1987; Sokol et al., 1980).

One important but frequently neglected component of prenatal care is substance abuse treatment. If the costs of fetal damage from tobacco and all types of drugs including alcohol are considered, the national bill could reach as high as $3 billion (Chasnoff, 1991). However, drug treatment facilities for pregnant women are grossly inadequate and fewer than 11 percent of pregnant women who need this care actually receive it (National Association of State Alcohol and Drug Abuse Directors, Inc., cited in GAO, 1990).

Prenatal care plans which include drug treatment for those women who need it can reduce the incidence of low birth weight among substance abusers from 50 to 18 percent (Finnegan, 1990).

Clearly, prenatal care can lower the incidence of low birth weight births and reduce medical costs. But many women lack access to prenatal care because they do not have health insurance. In 1990, 8.7 million women of child-bearing age lacked health insurance. In 1987, five million women of child-bearing age had private health insurance that did not cover maternity care (The National Commission to Prevent Infant Mortality, 1988). Infants of uninsured women are approximately 30 percent more likely to experience an adverse outcome (defined as a prolonged hospital stay, death, or transfer to a hospital with more intensive treatment facilities) compared to babies of similar women with insurance, and the differences are even greater among minorities (Braveman et al., 1989).

The good news for low-income pregnant women is that, as of 1990, states were required to provide Medicaid coverage for pregnant women with incomes below 133 percent of the poverty level ($9,044 for one person, $11,696 for two people), and may cover women with incomes up to 185 percent of poverty ($12,580 for one person, $16,269 for two people) (Committee on Ways and Means, U.S. House of Representatives, 1991). However expanding Medicaid has been shown to be less effective in increasing birth weights and improving access to prenatal care than is women's participation in more comprehensive programs which include prenatal outreach and comprehensive case management (Schlesinger and Kronebusch, 1990; Piper et al., 1990).

Medicaid coverage (if women can find providers willing to accept this insurance) allows access to routine care, but not to the comprehensive services which promote the best outcomes.

But comprehensive programs for high-risk pregnant women such as those provided in community and migrant health centers and through the Title V Maternal and Child Health Block Grant program are seriously underfunded, and federal support has been declining in recent years. Between 1979 and 1990, adjusted for inflation in the cost of medical care, federal expenditures for Maternal and Child Health Block Grants declined by 28 percent, fell 25 percent for Community Health Services-Primary Health Care Centers, and shrank by 34 percent for Migrant Health.

Cost-Effectiveness of Prenatal Care

The comprehensive programs just described are expensive. But the costs -- in economic terms alone -- of *not* providing these services are much greater. Between 150,000 and 200,000 infants (4 to 6 percent of all newborns) are treated in neonatal intensive care units (NICUs) each year, and half of these infants are there due to their low birth weight (OTA, 1987). In 1985, the cost of neonatal intensive care was $2.4-3.3 billion nationwide, and averaged $14,287 per infant treated (American Academy of Pediatrics, cited in GAO, 1987). In a 1985 study, the Institute of Medicine -- part of the National Academy of Sciences -- estimated that if comprehensive prenatal care were provided to all high-risk women, the savings for every dollar spent would be from $2 to $3.30 just in the first year (Institute of Medicine, 1985).

Providing prenatal care is the most cost-effective way to reduce infant mortality (Joyce, et al., 1988). Neonatal intensive care is the most expensive intervention, costing from forty to over one-hundred times more per life saved than does prenatal care. Because we do not provide comprehensive prenatal care for all women -- the most inexpensive way to prevent low birth weight births and infant deaths -- we must pay for neonatal intensive care instead.

EARLY CHILDHOOD EDUCATION

Providing comprehensive prenatal care is one way in which we, as a society, can improve the lives of children and their families, and also save money. Providing early childhood education services is another way. For all children, but especially for the disadvantaged, early childhood education provides a strong foundation for a lifetime of learning, and increases the chance that children will be successful in school and in the workplace and will reach their potential as fully contributing adults.

Head Start, the federally-funded early childhood education program for low-income children, has provided education and health and social services to more than eleven million children since 1965. Head Start is severely underfunded, and in 1990, only 30 percent of eligible children participated (see Table 3). In 1990, fewer than one in five children were in full day (six-hour) programs. Many low-income parents whose schedules cannot accommodate a half-day program for their child are forced to rely on other day care arrangements which often are less advantageous. Until Head Start schedules are expanded, or all other types of child care are enriched, disadvantaged children will fail to receive the full benefits of early childhood education.

TABLE 3
Head Start Participation by Age, 1990

Age	Children Enrolled (No.)	Income-Eligible Children (No.)
3	146,051	825,000
4	391,886	825,000
5	37,865	825,000
Total	575,802	2,475,000

Source: The National Commission on Children. *Beyond Rhetoric: A New American Agenda for Children and Families.* Washington, DC: United States Government Printing Office, 1991.

Effects on Intellectual Functioning

Early childhood education can reverse some of the effects of a disadvantaged environment and may prevent mild mental retardation, which in many cases is completely preventable (Martin et al., 1990). Head Start and other similar programs have repeatedly been shown to improve the cognitive ability of enrolled children (McKey et al., 1985). Participation has a strongly positive effect on immediate intellectual functioning. Achievement, IQ, and school readiness all rise significantly among Head Start participants compared to children of similar backgrounds who are not enrolled. Head Start also has an immediate, positive effect on children's self-esteem, achievement motivation, and social behavior. Unfortunately, it appears that these gains are lost within a few years after completing the program, once children enter the regular classroom (McKey et al., 1985; Lee et al., 1989; Berrueta-Clement et al., 1984; Lazar and Darlington, 1982).

School Performance, Educational Attainment, and Employment

The effects of early childhood education on intellectual functioning are not sustained once children leave the programs. But these programs have been shown to have long-term, positive effects on a wide range of other educational, social, and economic outcomes.

Many studies have shown that participation in early childhood education decreases the incidence of grade retention and placement in special education classes (McKey et al., 1985; Lazar and Darlington, 1982; Copple et al., 1987). A study of thirty-three Philadelphia Head Start programs over a ten-year period in the 1970s found that during the remainder of their school careers, former Head Start participants were less frequently retained in grade, had better attendance, and had lower drop-out rates than did nonparticipants of similar backgrounds. Twice as many nonparticipants as participants in Head Start spent time in special education classes. Students who attended preschool have higher school achievement and educational attainment throughout their school careers than do controls (see Table 4). Employment rates are higher, arrests for criminal acts and reliance on public assistance are lower, and the birth rate among the women is lower among preschool participants compared to controls (Berrueta-Clement et al., 1984; Weikert, 1989). Early intervention is especially important for low birthweight children, particularly those in disadvantaged environments (Chaikind and Corman, 1990; Infant Health Development Group, 1990).

Cost-Effectiveness of Early Childhood Education

The cost savings from preschool participation are enormous. Head Start participation can return up to $2.48 for every dollar invested (Schweinhart and Weikart, cited in Lazar and Darlington, 1982). Studies of the Perry Preschool Project also show that the benefits are greater than the costs. Overall, the social benefits for every child who attended the program for two years were three dollars for every dollar spent.

NUTRITION FOR PREGNANT WOMEN AND CHILDREN

Providing additional nutritious food to low-income pregnant women, children, and

TABLE 4
Documented Effects of Good Preschool Programs on Poor Children

Finding/Study	Program Group	Control Group
Intellectual ability (IQ) at school entry		
Early Training	96	86
Perry Preschool	94	83
Harlem	96	91
Mother-Child Home	107	103
Special education placements (%)		
Rome Head Start	11	25
Early Training	3	29
Perry Preschool	37	50
New York Prekindergarten (age 9)	2	5
Mother-Child Home (age 9)	14	39
Retention in grade (%)		
Rome Head Start	51	63
Early Training	53	69
Perry Preschool	35	40
Harlem	24	45
New York Prekindergarten	16	21
Mother-Child Home	13	19
High school dropouts (%)		
Rome Head Start	50	67
Early Training	22	43
Perry Preschool	33	51

Source: Weikart, David P. *Quality Preschool Programs: A Long-Term Social Investment.* Occasional Paper Number Five. New York: Ford Foundation, 1982.

infants is another investment which pays off in lower medical costs in the future. The main program which supplies this food is WIC -- the Special Supplemental Food Program for Women, Infants, and Children -- a federally-funded program which in 1990 provided food supplements, nutritional information, and health and social service referrals to 4.5 millon low-income, nutritionally-at-risk pregnant and postpartum women, infants, and children up to age five. Throughout its history, WIC has been underfunded. In 1990, only 60 percent of eligible women and children participated due to insufficient funding (Select Committee on Children, Youth, and Families, 1990).

WIC is successful in improving the nutrition of pregnant women and increasing the birth weights of their babies. WIC participation reduces the incidence of low birth weight by 16 to 21 percent, reduces the rate of premature births, and lowers neonatal mortality by nearly two-thirds (Kotelchuck, 1984; Stockbauer, 1987). Infant head circumference, an indicator of brain growth and development, is also greater with WIC participation during pregnancy (USDA, 1990). Benefits are greatest for high-risk women.

WIC is not just helpful for pregnant women; children and infants also benefit. WIC participation increases dietary intake of iron and reduces anemia (Miller et al., 1985; Rush, 1986). This is very significant since children who are iron deficient during the first two years of life may experience permanent developmental problems (*The Washington Post*, September 5, 1991).

Benefit-cost analyses show that the WIC program for pregnant women more than pays for itself. A study done for the U.S. Department of Agriculture compared the costs of WIC with the medical savings due to program participation. In 1987-88, for every dollar spent on the prenatal WIC program, the associated savings in Medicaid costs during the first 60 days after delivery ranged from $1.77 to $3.13 for mothers and infants, and from $2.84 to $3.90 for infants alone (USDA, 1990).

ROUTINE MEDICAL CARE FOR CHILDREN

Routine medical care for children, "well child care," includes components such as immunizations and lead screening which have proven to be cost effective. Vaccines which protect against common childhood infectious diseases have been a major medical success story. But the U.S., especially in recent years, is doing a very poor job of ensuring that all children receive standard immunizations. Among nations in the Western Hemisphere, the U.S. vaccinates a smaller share of children than all but the poorest countries in Central and South America (see Table 5, page 17).

Immunization rates in the U.S. are low and are falling lower (*The Washington Post*, October 9, 1991; Miller et al., 1989). In 1985, only 55 percent of children aged one to four had been vaccinated against polio, down from 66 percent in 1970. Just 65 percent of children in 1985 were immunized against diphtheria, pertussis, and tetanus (DPT), compared with 76 percent in 1970 (Department of Health and Human Services, 1991).

These inadequate immunization rates are especially tragic since vaccination is relatively inexpensive, but very effective in preventing illnesses which can be, at best, unpleasant, and at worst, fatal or permanently disabling. Many studies have repeatedly shown vaccination to be cost effective (White et al., 1985; U.S. Department of Health and Human Services Centers for Disease Control, cited in Select Committee for Children, Youth, and Families, 1990). During the first twenty years after it was licensed in 1963, the measles vaccine created a net savings of $5.1 billion (Bloch, 1985).

Another hazard of childhood is lead poisoning which results from ingesting lead-based paint chips or lead contaminated water, or from breathing lead contaminated air (removing lead from gasoline was directed toward lessening this problem).

TABLE 5
Measles Immunization in the Western Hemisphere

Percentage of 1-Year-Olds Immunized in the Americas in 1990

Panama	99%	Belize	81%
Anguilla	99%	Nicaragua	81%
British Virgin Islands	99%	Turks and Caicos	81%
Montserrat	99%	Brazil	77%
St. Kitts/Nevis	99%	Paraguay	77%
Chile	98%	El Salvador	75%
Dominican Republic	96%	Jamaica	74%
Argentina	94%	Suriname	74%
Cuba	94%	**United States[a]**	**70%**
Honduras	91%	Guatemala	68%
Antigua	89%	Mexico	66%
Barbados	87%	Peru	64%
Bahamas	86%	Venezuela	64%
Costa Rica	85%	Grenada	63%
Colombia	82%	Ecuador	62%
St. Lucia	82%	Bolivia	53%
Uruguay	82%	Haiti	31%

[a] For 2-Year-Olds.

Source: *The Washington Post.* Sunday, March 24, 1991, p. A23

Children with high blood lead levels may experience anemia or neurological and physiological deficits which can persist to adulthood (Needleman et al., 1990). Fetal exposure is also damaging (Dietrich et al., 1987). An estimated 3.75 million children suffer from lead poisoning (Select Committee on Children, Youth, and Families, 1990). The problem is most prevalent among children in the central city and very high blood lead levels are nine times more likely among children of the very poor compared to children in middle-class homes. Black children are six times more likely than whites to have elevated levels.

Annual screening of blood lead levels allows early, asymptomatic cases to be detected so intervention can prevent the levels from climbing higher and causing significant effects. For most children the costs of inexpensive screening tests and treatment are lower than the costs of managing the learning disabilities and mental retardation which would result in the absence of these measures (Berwick and Komaroff, 1982). But, there is currently no comprehensive, nationwide effort to monitor lead levels in children, and reports of the prevalence of elevations are only done on a voluntary basis by some states (Miller et al., 1989). Once elevated levels are detected, there is little money for treatment or preventive measures.

CONCLUSION

Too many children in this country spend their first few years of life in disadvantaged environments which can stunt their potential to learn, to work, and to contribute. Excellent, comprehensive prenatal care, good nutrition and medical care, and intensive early childhood education programs would provide at-risk children with the resources needed to increase their chance to reach their full potential. But as a society, we fail to provide these preventive programs and supportive services to all children. As a result, too often we must later undertake corrective actions, such as intensive curative medical care and remedial education, that are usually more expensive and less effective than the preventive services would have been. Both on humanitarian and economic grounds, we can no longer waste the talents of our people, but must invest the resources to ensure that all children reach their full potential.

SECTION II: INVESTING IN FORMAL EDUCATION

Formal education -- primary and secondary school and post-secondary education -- historically has made a major contribution to U.S. economic and productivity growth. These beneficial effects occur because education makes workers more productive; on average, better educated workers are more skilled and can do their jobs more effectively. This leads to better job performance and higher earnings for individuals, and to higher productivity and economic growth for the society. By preparing scientists and engineers, education also contributes to the pace of technological change through research and development efforts into new technologies, products, and processes.

But just because more educated workers receive higher wages, we cannot conclude that the earnings differentials always reflect higher productivity or advanced skills that result from increased schooling. There can be many other factors at work such as family background, hiring preferences, or innate ability that affect wage levels and educational attainment, and distinguishing these separate effects can be difficult. Studies which calculate the effects of schooling on individual earnings and on national economic growth must be examined carefully to avoid overestimating education's contributions. But even when this is done, the benefits of education remain very large.

To reap the advantages of an educated labor force, jobs must be available and work must be organized so that workers' skills are utilized. Throughout the first sixty to seventy years of this century, while some people were engaged in advanced learning, for most Americans, increased academic ability meant becoming literate and numerate. The performance of nearly every job could be improved when workers acquired these basic skills. In the future, education will continue to contribute to economic growth only if average education levels continue to rise *and* if these higher skills are utilized on the job.

SCHOOLING AND JOB PERFORMANCE

Job performance improves with rising intellectual achievement. General cognitive abilities -- the verbal and mathematical skills that are learned early in school and are further developed during progress through the educational system -- are used everyday in most jobs, even those generally thought of as nonintellectual and consisting predominantly of manual labor. Education improves these cognitive skills, and can teach more specialized knowledge as well, all of which enhance workers' performance on the job, although the importance of cognitive ability is greater for jobs of relatively higher complexity (Wise, 1975; Hunter, 1986, 1981a, 1981b, 1980a, 1980b; Hunter and Hunter, 1984; Weisbrod and Karpoff, 1968; Ghiselli, 1966).

When workers are watched while actually doing the skills required by their jobs, observers find that performance improves with rising levels of cognitive ability. Also, supervisors' ratings of employees are higher on average for more educated workers, even within a single job category. These ratings are in some ways more subjective and potentially less accurate than are the job skill observations done by outsiders. But in other ways, they are potentially more accurate because included in the assessment is a consideration of a wide variety of work habits and abilities, as well as the level of effort and how well the worker interacts and cooperates with co-workers. That these ratings also correlate with education level speaks to the importance of a wide range of skills and attributes learned and acquired in school which enhance job performance.

Years of experience or learning on the job do not offset initial differences in knowledge. For example, if two workers are hired to do identical jobs, the worker with the better cognitive skills at the time of hiring will continue to be more productive even after five years on the job (Schmidt, 1988). That is, the less educated worker's initial cognitive disadvantage is not overcome by on-the-job learning.

There is clear evidence that with more education and higher cognitive ability, training is easier to do and more successful. More educated workers learn relatively more quickly than do workers with less education and they will more quickly adopt and implement innovations. Testing within the armed services shows that science and verbal skills have a particularly strong, positive effect on success in training (Bishop, 1991).

When technology is changing rapidly, either at certain periods in history or in particular industries at a given point in time, education and cognitive ability are especially important. New technology cannot be fully implemented until workers have learned how to use it -- have learned how it works, how to avoid problems, and how to trouble-shoot and repair it -- and discover how best to integrate it with other aspects of their job. Education and cognitive skills increase workers' ability to deal with these new situations and solve problems creatively. In industries with rapid productivity growth and rapid introduction of new technology, there is an increased need for more educated workers. These industries pay higher wages for educated workers than do less innovative industries employing workers with similar skills, and wages rise more rapidly (Bartel and Lichtenberg, 1988, 1987; Mincer, 1989; Nelson and Phelps, 1966).

Currently, economists and industrial psychologists are debating whether written examinations that test verbal and mathematical ability can be used to predict workers' job performance. If education and learned abilities are so important, it is argued that examining workers to find those with the highest test performance will also identify those workers who will perform best on the job. And if high school graduates knew their job prospects would be partially dependent upon results of verbal and mathematical testing, this might persuade them to put more effort into their studies (Bishop, 1989b; 1988b). However, others argue that many skills other than those measured by written tests are also important -- such as effort, ability to cooperate with co-workers, and creativity. Making hiring decisions based exclusively on written test results will fail to select workers with these other equally important skills. But there is some evidence that even if testing could select an improved workforce for a single employer, for the society as a whole, the costs of testing may outweigh the benefits (Levin, 1988; Mueser and Maloney, 1991). In any case, whether these tests are helpful for selecting workers, ignore so many important factors as to be of marginal value, or create social costs which outweigh their benefits, the connection between cognitive abilities and job performance is not in question.

SCHOOLING AND EARNINGS

The importance of schooling to the economy is further confirmed by evidence that workers' earnings generally rise with increases in the quantity or quality of education. This occurs, in part, because education and increases in workers' abilities enhance job performance in all types of jobs. Also, on average, better educated and better trained workers have skills which less educated workers do not have. Jobs requiring these specialized skills often pay higher wages.

Estimates of the effects of education on the economy depend upon the assumption that wages (actually wages plus the value of all fringe benefits) reflect a worker's productivity -- a worker's skill and speed at producing high-quality products. Of course productivity depends upon the materials, tools, and equipment available to the worker, and upon the way in which work is organized. But even considering these other factors, wages do not always correlate with productivity, a statement which will probably not surprise anyone who has ever had a job.

There are many factors other than productivity and skills that influence wages. Discrimination based on both race and sex lowers wages for minorities and women in ways unrelated to actual job performance. Some industries and regions of the country have traditionally paid relatively higher wages, and large firms typically pay more than do small firms. These factors make wages an imperfect measure of productivity and introduce error into wage-based estimates of the contributions of education.

More educated workers may receive higher wages for reasons unrelated to productivity advantages or special skills. It has been argued that education, especially post-secondary education, is nothing more than a screening and credentialing process, a way to keep some workers in inferior jobs while allowing others access to higher paying positions. According to this view, going to college is similar to an initiation process into a select club, and once the educational process is complete, the recipient of the credential reaps the rewards of membership -- a high-paying job. In this view, wages received by higher educated workers do not reflect higher productivity, but access to higher paying jobs as a result of additional education.

Particularly in jobs available to high school graduates, there is good evidence that better job performance and higher productivity do not necessarily translate into higher wages (Bishop, 1988a, 1989b). Others have gone so far as to write "[o]nly under extremely strong assumptions. . . will earnings offer a reliable guide to the quality [skill levels] of employed labor" (Wolff and Howell, 1990).

Actually, workers' wages are determined by a combination of factors, including skill and productivity levels, a credentialing process, discrimination, and industry and regional variables. But empirical studies of workers' economic contributions frequently assume that wage differentials solely reflect differences in productivity and skills, and ignore these other factors. This can overstate the benefits of education. These points must be kept in mind as we review the evidence on the effects of education on the economy and on individual productivity and earnings.

The Quantity of Schooling

The educational attainment of the U.S. population has risen markedly in the past fifty years. The median number of years of schooling completed has risen from 8.6 in 1940

-- half the population had not even started high school -- to 12.7 in 1987 when half of the population had completed some schooling beyond high school (Bureau of the Census, 1988). In 1987, 20 percent of all people twenty-five years old or over had finished college: 21 percent of whites, 11 percent of blacks, and 9 percent of Hispanics. In 1990, average annual earning of a full-time, full-year working male high school graduate was about $28,000, 20 percent greater than the average earnings of a man who completed at least eight but fewer than twelve years of school. Average earnings for male college graduates were about $45,000, or 60 percent more than for high school graduates, while for those with five or more years of college, earnings averaged twice the level of those with just a high school diploma (see Table 6).

TABLE 6
Average Earnings of Full-Time, Year-Round Workers by Education Attainment, Sex, and Race; Age 25 to 64, 1990

	Elementary	High School		College		
	8 years or less	1-3 years	4 years	1-3 years	4 years	5 or more years
MALE						
All Races	$19,311	$22,650	$28,085	$34,186	$44,586	$55,951
White	19,339	23,253	28,877	35,019	45,610	56,690
Black	19,692	19,028	22,231	27,954	33,088	41,692
Hispanic	16,255	19,670	23,175	28,961	36,283	52,470
FEMALE						
All Races	$13,319	$15,297	$18,966	$22,661	$29,001	$35,966
White	13,481	15,235	19,117	22,862	29,254	35,849
Black	12,559	15,798	17,929	21,374	28,048	33,469
Hispanic	12,096	13,793	17,487	22,022	25,593	32,035

Source: U.S. Department of Commerce, Economics and Statistics Administration, Bureau of the Census. *Money Income of Households, Families, and Persons in the United States: 1990.* Current Population Reports, Consumer Income, Series P-60, No. 174.

Lifetime earnings rise with level of education. For example, in 1984 an additional year of education at the high school level would have added $96,000 ($51,000) to the lifetime labor income of a man (woman), where labor income includes both a paying job and the monetary value of non-labor force activities, such as raising children (Jorgenson and Fraumeni, 1989) (see Table 7).

As years of schooling increase, wages and lifetime earnings rise, unemployment falls, and work lives lengthen. More educated workers on average have higher annual and lifetime earnings, not just because their hourly pay is higher, but also because they are less likely to be unemployed and have shorter spells of unemployment than do less educated workers. In March 1988, for example, the unemployment rate among all adults without a high school diploma was 9.4 percent, 5.4 percent among high school graduates, 3.7 percent

TABLE 7
Increase in Lifetime Labor Income[a] Due to an Additional Year in School, 1984
(Thousands of 1984 $)

		Male			Female		
Year	Total	Grades 1-8	High School	College	Grades 1-8	High School	College
1984	$65.3	$28.0	$96.4	$188.9	$8.2	$51.4	$162.1

[a] Includes both market and nonmarket activities.

Source: Jorgenson, Dale W. and Barbara M. Fraumeni, "Investment in Education," *Educational Researcher.* May 1989, pp. 35-44.

among those with some post-secondary education, and 1.9 percent for those with four years of college (LeGrande, 1988).

During past recessions, people with relatively less education experienced larger increases in unemployment than those with college degrees. During the January-July 1980 recession, for example, the unemployment rate for high school graduates increased by over 100 percent, while for college graduates, the rate rose just 44 percent (LeGrande, 1988). This pattern occurred in part because college graduates commonly worked in the service sector, not in manufacturing, and demand for manufactured goods, and consequently employment in manufacturing, has historically experienced greater declines during recessions than demand and employment in services. The rise in service sector employment and the decline in manufacturing, as well as changes within the service sector itself, suggest that future recessionary unemployment effects may be more equally shared among workers in both sectors and at all levels of educational attainment -- a trend that is already apparent during the 1990-91 recession.

More educated workers generally have longer worklives and retire at an older age than workers with relatively less education. A man with less than a high school education on average will work thirty-five years in his life, while a man with fifteen years of schooling will average forty-one years, six years more (LeGrande, 1988). In 1987, among men aged forty-five to fifty-four, 95 percent of college graduates earned wages or self-employment income, while among men of the same age with schooling beyond the elementary level but who did not graduate from college, only 76 percent were earning income (Burtless, 1990).

An individual's increased earnings due to schooling and the social economic benefits of education are overestimated if the effects of other factors that contribute to higher earnings are not also considered. Since people with more innate ability often obtain more years of education, the separate effects of each on earnings must be distinguished. When the effects of education on earnings are separated from the effects of intelligence, the contribution of native intelligence is quite small. Only about 10 percent of the increases in wages due to education are actually due to intelligence (Griliches and Mason, 1972; Burtless, 1990). And childhood IQ has little influence compared to adult achievement (Husen, 1969). It is learning, not aptitude at a young age or intelligence, that is the important factor in determining wages (Bishop, 1991; Tuijnman, 1989).

Studies of the benefits of education which adjust for intelligence (Griliches and Mason, 1972; Taubman and Wales, 1975) and for family background and other socioeconomic characteristics (Behrman et al., 1977; Olneck, 1977) show that while monetary returns to education are reduced when these other factors are considered, schooling still raises earnings substantially. For example, in 1980 among forty-to fifty- year-old men, an additional year of high school raised earnings by 7 to 10 percent, after adjusting for ability and family background (Angrist and Krueger, 1990).

When many variables are examined in an attempt to explain earnings --including general academic achievement, years of schooling, age, race, father's education, father's occupation, rural/urban place of birth, and other factors -- each additional year of school raises wages by 5 to 7 percent, and a one standard deviation improvement in test scores measuring general academic achievement raises wages by 21 percent (Bishop, 1991; Card and Krueger, 1990; Burtless, 1990).

Schooling raises general cognitive ability, IQ, and scores on general aptitude tests (Burtless, 1990). As a result of increases in educational attainment, average U.S. IQ scores rose between 1918 and 1965; the *average* student in 1965 was scoring at a level that only the top 16 percent of students achieved in 1918. Furthermore, scores for blacks and some other disadvantaged groups have risen relative to scores for whites as more and better education has been available for these groups (Burtless, 1990). Early childhood education for at-risk children has also raised IQ scores. Thus, studies show IQ is not fixed unalterably at birth as the final determinant of future ability, but is influenced by education. Also, it is achievement -- the result of effort and schooling -- rather than innate intellectual talent that is most important for earnings. One researcher concludes:

> [T]he associations between scores on employment aptitude and IQ tests on the one hand and productivity and labor market success [high wages and low unemployment] on the other arise because the tests measure *developed abilities and knowledge* that contribute to productivity. This suggests that an increase in the incidence of these developed abilities in the working population will increase national output. (Bishop, 1991, p. 19, emphasis in original)

Overall, even after adjustments are made for other influences on earnings such as family background, race, and innate ability, education -- measured by increases in years of schooling -- has a big payoff, both to individuals and to society.

The Quality of Schooling

The quality of schooling, as well as its amount, affects earnings. Students who attend higher quality primary and secondary schools -- measured by larger per pupil expenditures -

- receive higher wages during their worklife (Morgan and Sirageldin, 1968; Johnson and Stafford, 1973; Link and Ratledge, 1975; Akin and Garfinkel, 1977; Tremblay, 1986). This is true, even after adjusting for other influences such as the father's education. Even the wages of college graduates are influenced by the quality of their primary and secondary education (Card and Krueger, 1990; Wachtel, 1976).

Students who attend higher quality public primary and secondary schools -- indicated by lower pupil-teacher ratios, higher relative pay for teachers, and longer length of the school year -- earn higher wages (Card and Krueger, 1990). For example, if pupil-teacher ratios were lowered by five students, the earnings of high school graduates would rise by nearly 2 percent, and those of college graduates by nearly 4 percent. Adjusting for income or education levels of the parents' generation does not change these findings, and the effects are similar for blacks and whites. Each of the three school quality factors independently raise future earnings.

Higher quality schooling also is correlated with a greater number of years of schooling. Students attending higher quality primary and secondary schools are more likely to finish high school and continue into post-secondary education than are students attending lower quality schools. This makes an additional contribution to earnings from high-quality education.

Better college grades and college quality correlate with higher salaries and promotions, after controlling for the socioeconomic background of students and their innate intelligence (Wise, 1975). However, for high school graduates, enhanced abilities as reflected in better high school grades or higher test scores are not rewarded with higher wages, in part because employers do not seek out this information by requesting high school transcripts. Since these learned abilities are generally not rewarded in the job market for high school graduates, this lowers incentives to do well in high school (Bishop, 1988a, 1988b, 1989b).

Earnings for blacks and whites with the same level of education have long been unequal. While discrimination in hiring and promotion accounts for some of the differences in earnings, an additional cause is the lower quality education often received by blacks. Improvements in the quality of blacks' education have narrowed the earnings gap in recent years (Card and Krueger, 1990; Welch 1966, 1967, 1973a, 1973b; Freeman, 1973; Smith and Welch, 1989).

Though the quality of schooling has consistently been shown to affect students' future earnings, the mechanism of how this occurred was not clear since it appeared that achievement as measured by test scores did not rise with quality improvements. Numerous studies dating from Coleman's *Equality of Educational Opportunity* published in 1966 have examined the relationship between student achievement and various measures of school quality and expenditure levels and have found no consistent effects (Coleman et al., 1966; Hanushek, 1989, 1986; Averch et al., 1972; Mosteller and Moynihan, 1972), although many others have challenged these findings (Bowles and Levin, 1968a, 1968b; Cain and Watts, 1968; Smith, 1972; Bowles, 1968). There are serious methodological problems with much of this work -- many of which were unavoidable given the limited nature of the data and the difficulties inherent in doing social "experiments" -- but the intuition that higher quality schooling raised achievement could not be shown conclusively. (It is interesting that despite this lack, the courts have consistently upheld the need to equalize school funding among districts.)

However, recent well-designed studies are showing that improved school quality does raise achievement. The most compelling evidence comes from an experiment in Tennessee conducted between 1985 and 1989 (Finn and Achilles, 1990; Word et al., 1991; Nye et al., 1991). Some 6,500 students in seventy-eight elementary schools participated in the only prospective study ever conducted on the effects of class size. Students in kindergarten and first grade were randomly assigned to classes with one of three different pupil-teacher ratios, and students remained in classes of the assigned size through the end of third grade. By the end of first grade, students in classes with the lowest pupil-teacher ratios (thirteen to seventeen pupils per teacher) were outperforming students in the other two categories (twenty-two to twenty-five students per teacher and twenty-two to twenty-five students with one teacher and one teacher's aide) by statistically and educationally significant margins in both math and reading. These results were present in urban, rural, inner-city, and suburban schools, and the small class advantaged both white and minority students, although minority students were particularly helped. These results persisted during grades two and three as well.

At the beginning of fourth grade, all students returned to the regular classroom. And at the end of that year, students who had been in the small size classes were continuing to outperform students from the other two class sizes on every measure and at all locations. (Researchers will continue to follow these students as they progress through elementary and secondary school.) This experiment conclusively shows that small class size improves student achievement. Due to the methodological rigor of the study's design and implementation, the findings are very difficult to challenge.

Another factor which fairly consistently has been shown to raise student achievement is teacher knowledge and ability, particularly verbal skills (Strauss and Sawyer, 1986; Hanushek, 1971). Recent studies confirm this effect. A study of Texas schools showed that differences in school quality accounted for one-quarter to one-third of the variation among school districts in students' scores on a standardized reading test, and most of the quality differences were due to variations in teacher quality. Higher scores on a statewide recertification exam, increasing years of experience, and earning a master's degree accounted for most of the school quality differences (Ferguson, 1991). Another study found that class sizes of eighteen or fewer students and teacher characteristics such as strong language skills, relatively more experience, and a master's degree all contributed to improved performance on standardized reading and math exams by students in primary and secondary school (Ferguson, 1990).

It has been shown repeatedly that improved school quality raises earnings. But until recently, the mechanism by which school quality was translated into higher earnings was unclear, since the effects of quality on achievement were inconclusive in earlier work. Recently however, better data and new studies are beginning to demonstrate a connection between school quality, higher achievement and higher earnings.

THE RETURNS TO HIGHER EDUCATION

College and university education is particularly beneficial for both individuals and society. Undergraduate education has a greater affect on earnings than does either secondary or graduate school (Jencks, 1979; Goodman, 1979). After controlling for work experience, intelligence, and family background, a high school diploma raises earnings by 15 to 25 percent over the earnings level of an eighth grade graduate, and a college degree raises earnings by 18 to 47 percent above those of a high school graduate. Additions to earnings due to post-graduate education are lower than those for undergraduate schooling and vary widely depending on the field of study or professional training. For example, finishing a Ph.D. degree and becoming a college professor earns an average rate of return of about 0.8 percent (a very poor investment in financial terms) while for other post-graduate degrees, particularly in fields such as medicine or law, returns are much higher.

An individual's lifetime rate of return from an investment in university or college education averages 10 percent (Leslie and Brinkman, 1988). This means that for an investment alternative to be more profitable, the tuition, expenses, and foregone wages which are the cost of a college education would have to be invested and earn an annually compounded return for 30 to 40 years that was greater than 10 percent. Such investments are hard to find; higher education is one of the most profitable investments individuals can make.

These figures show only the *financial* returns to an *individual.* But college education may also enhance the enjoyment of other activities such as reading, plays, or concerts, or may enable people to make wiser decisions. Society also benefits because higher earners pay higher taxes, and well-educated people are more likely to contribute to the growth in knowledge, and develop new products or production methods. An educated populace is also important to a well-functioning democratic state.

Social rates of return to undergraduate education (the rate by which the financial benefits received by all of society exceed total private and public expenditures) are about 12 percent (Leslie and Brinkman, 1988). These calculations ignore nonfinancial benefits to individuals, and social returns (except taxes) which are not captured by individuals, such as research and development advances due to work done in institutions of higher education.

The type of post-secondary institution attended has only a slight affect on earnings. For students who receive the first two years of their college education at a two-year, as opposed to a four-year institution, the lifetime earnings differences are trivial, provided the community college students finish the additional two years needed for a college degree (Pascarella and Terenzini, 1991).

Attending a higher quality college, as measured by average freshman SAT or ACT scores, may raise earnings by approximately one percent after accounting for other factors which affect earnings such as family background, intelligence, achievement, motivation, and occupational status (Morgan and Sirageldin, 1968; Smart, 1988; Reed and Miller, 1970). However, educational attainment such as completion of a bachelor's degree and attendance in graduate or professional school rises with college quality. When all these influences are considered, attendance at a higher quality college can raise earnings between 15 and 30 percent.

A SHORTAGE OF COLLEGE-EDUCATED WORKERS

Despite the importance of college-educated people and the financial benefits of post-secondary education, we have a shortage of these workers. Perhaps the most impressive evidence that we need to invest more in education is the rapid increase in the wages earned by college-educated workers relative to high school-educated workers over the last decade. Essentially, the labor market is signalling a demand for college-educated workers that is going unfulfilled.

The data in Table 8 track the weekly wage (inflation-adjusted) of workers by education level and gender over the 1963-1987 period. The last three decades have seen the wages of more educated workers, men and women, rise more rapidly those of other workers. The only exception is during the 1970s when a rapid increase in the number of college graduates, partly induced by the draft and the baby boom, caused the wages of college educated workers to fall relative to others and in absolute dollars.

In the 1980s, however, the wage premium received by college-educated workers (measured as the ratio of the wages of college-educated to high-school educated workers) rose rapidly (see column 6, Table 8). Since there was a relative increase in the supply of college graduates during this period, the higher wage premium suggests that employer demand for college graduates significantly increased. This trend has been verified in a variety of studies (see Bishop, 1991; Murphy and Katz, 1990; Levy and Murnane, 1992). In fact, the college wage premium reached its historical peak in the late 1980s.

Various analysts have suggested that this higher wage premium implies the need to increase the share of the workforce with a college degree from its current level of 25 percent to about 30 percent. To do so would require a major expansion of higher education enrollment and completion rates.

There are some reasons to believe, however, that the growth in the wage premium for college educated workers may overstate the recent growth in employer demand for such

TABLE 8
Weekly Wage Trends by Education Level, 1963-87
($1989)

	(1) Less Than High School	(2) High School Graduate	(3) Some College	(4) College or More	(5) High School/ Dropout	(6) College/ High School
			MEN			
Weekly Wage						
1963	$293.50	$356.91	$414.42	$522.22	1.22	1.46
1971	350.32	423.53	485.17	678.67	1.21	1.60
1979	349.10	429.90	465.02	608.31	1.23	1.42
1987	323.64	397.97	459.14	650.68	1.23	1.63
Percent Change						
1963-71	19.4%	18.7%	17.1%	30.0%		
1971-79	-0.4	1.5	-4.2	-10.4		
1979-87	-7.3	-7.4	-1.3	7.0		
			WOMEN			
Weekly Wage						
1963	$173.88	$210.45	$235.55	$317.34	1.21	1.51
1971	201.33	245.95	282.99	397.61	1.22	1.62
1979	207.79	248.81	280.29	371.66	1.20	1.49
1987	202.47	261.45	307.67	416.35	1.29	1.59
Percent Change						
1963-71	15.8%	16.9%	20.10%	25.3%		
1971-79	3.2	1.2	-1.0	-6.5		
1979-87	-2.6	-5.1	9.8	12.0		

Source: Katz, Lawrence and Kevin Murphy. "Changes in Relative Wages, 1963-1987: Supply and Demand Factors." *Quarterly Journal of Economics,* 1991.

workers. The increased wage gap between college-and high school- educated workers is partially due to the absolute *fall* in wages among less educated workers, especially men. And, a significant if not predominant amount of the wage decline is due to factors (mostly) unrelated to changing skill requirements: a shift from high to low paying industries, deunionization, a shift to smaller firms, the rise of temporary and part-time jobs, deregulation and import pressures (Blackburn et al, 1990, Mishel and Frankel, 1990). However, declining wages for high school graduates do not fully explain the rising wage premium for college-educated workers and it is certainly true that there has been a steady growth of relative demand for educated workers in recent years.

Since 1987 (the last year shown in Table 8) the wage premium for college- educated workers has not risen. This implies that whatever factors drove the earlier rise in the returns to education may have exhausted themselves and/or that supply has now caught up with demand. Since data on college degrees awarded in the late 1980s show only modest growth, one can assume that there has been an amelioration of earlier demand side trends. That is, the relative demand for college-educated workers is increasing more slowly and the relative supply of college-educated workers is expanding to meet the higher demand.

The recent wage data are thus telling us that we currently have a shortage of college graduates but we will not face a *growing* shortage so long as we are able to maintain the recently achieved higher rates of college graduation. This assumes, however, that college graduation rates continue at their higher levels despite the cutbacks in public support for higher education during recent state budget crises.

However, maintaining the current state of affairs is not sufficient. To satisfy both the increasing need for college graduates and the pent-up demand developed prior to 1987 (as reflected in persistent high wage premium) requires that we expand college enrollment and completion rates even further. This in turn, means that a growing percentage of our high school graduates must be academically qualified for and financially able to pursue higher education.

COMPENSATORY EDUCATION

The federal Chapter 1 program provides money to states and school districts for the special educational needs of disadvantaged, migrant, neglected, and delinquent children. Funds are specifically targeted to reach low-achieving students who attend schools with high concentrations of poor children compared to other schools in the district in which the school is located. Only a small proportion of Chapter 1 participants achieve at levels close to or above the national average, but many students with low achievement do not receive Chapter 1 assistance. About five million children (some 11 percent of all students) participate in the program. Over 90 percent of school districts, including 60 percent of all public schools and 75 percent of public elementary schools, receive Chapter 1 funds. Also eligible are educationally disadvantaged students in Chapter 1-eligible districts who attend private school (Kennedy et al, 1986; Birman et al., 1987).

Chapter 1 students receive extra instruction in areas of need, most commonly reading (75 percent), math (46 percent), or both. About 70 percent of participants are in grades one through six. Some students participate for a few weeks or months while others may receive services for years. Each year approximately 40 percent of the participants are new to the program, and in many districts, up to 25 percent or more of all students will be served by Chapter 1 at some time during their elementary and secondary school years (Kennedy et al., 1986). Chapter 1 students leave the regular classroom to receive this special instruction, reducing the number of remaining students thus enriching their educational experience as well.

All these factors make it difficult to determine the effects of participation on achievement. When students take standardized tests, it is not usually known who currently or formerly was served by Chapter 1, nor for how long they participated. One way to attempt to determine the success of Chapter 1 is to examine the achievement of all disadvantaged children, although this will not directly indicate the specific effects of the program. The National Assessment of Educational Progress (NAEP) gathers nationally representative achievement data on nine-, thirteen-, and seventeen-year-old students. NAEP does not identify Chapter 1 participants, but does identify low-achieving students, students from disadvantaged urban communities, and minority students. These are all groups with a large share of Chapter 1 participants. Among these students, achievement in both math and reading has been improving much more rapidly than among the student population as a whole (see Table 9, page 32). Achievement has been rising much more rapidly among low achievers than among high achievers (see Table 10, page 33) and in disadvantaged urban communities more than in advantaged communities, especially in reading (see Table 11, page 34). Students show greater improvements in reading and math than in science. Gains are greatest among nine-year-olds. And blacks and Hispanics are improving faster than whites (LaPointe, 1984; Riddle, 1984; Kennedy et al., 1986).

It is probable that much of this improvement is due to the Chapter 1 program, but other ongoing changes may also have played a role. In the 1970s, school integration increased, there was a heightened focus on basic skills, and states and localities increased their aid for disadvantaged students. On the other hand, childhood poverty has risen from 16.4 percent in 1979 to 19.6 percent in 1989. Rates rose from 12 to 15 percent among whites, from 41 to 44 percent among blacks, and from 28 to 36 percent among Hispanics. While poverty is often accompanied by poor performance in school, disadvantaged and low-achieving children are having greater success in school in recent years, and it is probable that Chapter 1 is contributing to this trend.

Students who receive Chapter 1 services score higher on achievement tests than do similar students who do not participate, especially in reading (Stonehill and Anderson, 1982; Kennedy et al., 1986). However, these improvements still leave Chapter 1 participants far below the achievement levels of more advantaged students. For example, in grades three through eight, prior to their Chapter 1 participation, students on average finished the school year at about the twenty-third to twenty-fourth percentile in reading ability. At the end of the school year during which they participated in Chapter 1, average scores had risen to the twenty-seventh to twenty-ninth percentile, an improvement of 3 to 6 percentile ranks (Kennedy et al., 1986) (see Table 12, page 35). (An average student would be at the fiftieth percentile at the end of both years.) These advances occurred despite evidence that, in general, lower achieving students tend to fall further and further behind their higher achieving peers as years pass. In fact, low achieving students who do not receive Chapter 1 services often display declines in percentile rankings between the beginning and end of the school year. So the achievements of the Chapter 1 students, while modest, are notable. Unfortunately, due to inadequate data no studies of the relationship between program costs and effects have been conducted.

TABLE 9
Achievement in Mathematics[a] By Race: Selected Years, 1970s-1980s

Score	Average Mathematics Proficiency				Change	Difference from White	
	1973	1978	1982	1986	1973-86	1973	1986
Age 9							
Total	219.1	218.6	219.0	221.7	2.6		
White	224.9	224.1	224.0	226.9	2.0		
Black	190.0	192.4	194.9	201.6	11.6	34.9	25.3
Hispanic	202.1	202.9	204.0	205.4	3.3	22.8	21.5
Age 13							
Total	266.0	264.1	268.6	269.0	3.0		
White	273.7	271.6	274.4	273.6	-0.1		
Black	227.7	229.6	240.4	249.2	21.5	46.0	24.4
Hispanic	238.8	238.0	252.4	254.3	15.5	34.9	19.3
Age 17							
Total	304.4	300.4	298.5	302.0	-2.4		
White	310.1	305.9	303.7	307.5	-2.6		
Black	269.8	268.4	271.8	278.6	8.8	40.3	28.9
Hispanic	277.2	276.3	276.7	283.1	5.9	32.9	24.4

[a] National Assessment of Educational Progress.

Source: Dossey, John A., Ina V.S. Mullis, Mary M. Lindquist, and Donald L. Chambers. *The Mathematics Report Card: Are We Measuring Up?* Princeton, NJ: Educational Testing Service. Report No. 17-M-01, June 1988.

TABLE 10

National Assessment of Educational Progress Test Scores, by Subject, Race, Age, and Achievement Quartile During the 1970s[a] Change in Percent of Correct Items

(In Percentage points)

	Black Students			White Students		
Age	Reading	Science	Math	Reading	Science	Math
Lowest Achieving 25% of Students						
9	8.4%	-0.7%	2.9%	4.6%	1.7%	-0.5%
13	3.5	1.3	2.6	1.5	2.0	0.3
17	1.1	-0.5	1.6	-1.7	0.7	-1.8
Highest Achieving 25% of Students						
9	3.0%	1.1%	2.6%	1.2%	-2.4%	-3.3%
13	2.5	-0.5	-2.5	0.4	-4.1	-3.2
17	-1.1	-3.9	-5.5	-0.3	-4.2	-4.3

[a] The specific time intervals vary with the subject. In reading, the test points were 1970, 1974, and 1979. In mathematics, they were 1972, 1977, and 1981. In science, they were 1969, 1972, and 1976.

Source: Kennedy, Mary M., Beatrice F. Birman, and Randy E. Demaline. *The Effectiveness of Chapter 1 Services.* Washington, D.C.: U.S. Department of Education, Office of Educational Research and Improvement, July 1986.

TABLE 11
Achievement in Reading[a] By Race and Community
Selected Years, 1970s-1980s

Average Reading Proficiency

	1971	1975	1980	1984	1988[b]	Change 1971-88[c]	Difference from White Score	
							1971/1975[d]	1988
Age 9								
Total	207.3	210.2	214.8	211.0	211.8	4.5		
Race								
White	213.8	216.6	221.3	218.3	217.7	3.9		
Black	170.0	181.3	189.2	185.7	188.5	18.5	43.8	29.2
Hispanic[e]	--	182.8	189.5	187.2	193.7	10.9	33.8	24.0
Community								
Rural	200.7	204.0	210.3	205.8	228.3	27.6		
Disadvantaged Urban	177.6	185.1	166.0	194.4	208.3	30.7		
Advantaged Urban	231.3	226.2	231.9	231.4	247.5	16.2		
Age 13								
Total	255.2	256.0	258.5	257.1	257.5	2.3		
Race								
White	260.9	262.1	264.4	262.6	261.3	0.4		
Black	222.4	225.7	232.4	236.0	242.9	20.5	38.5	18.4
Hispanic[e]	--	232.5	236.8	239.6	240.1	7.6	29.6	21.2
Community								
Rural	245.0	247.9	254.3	255.5	270.5	25.5		
Disadvantaged Urban	232.4	229.1	241.6	239.6	247.4	15.0		
Advantaged Urban	272.4	271.5	275.2	274.7	273.9	1.5		
Age 17								
Total	285.4	286.1	285.8	288.8	290.1	4.7		
Race								
White	291.4	293.0	293.1	295.6	294.7	3.3		
Black	238.6	240.4	242.5	264.2	274.4	35.8	52.8	20.3
Hispanic[e]	--	252.2	260.7	268.1	270.8	18.6	40.8	23.9
Community								
Rural	275.8	261.3	278.1	282.8	287.7	11.9		
Disadvantaged Urban	258.4	261.0	258.8	265.9	269.4	11.0		
Advantaged Urban	303.5	301.2	299.1	300.8	296.0	-7.5		

[a] National Assessment of Educational Progress.

[b] Scores by community are from cross sectional data.

[c] For Hispanics, change in reading is for 1975-1988.

[d] 1971 for blacks, 1975 for Hispanics.

[e] No data were available for Hispanic students in 1971.

Sources: Jenkins, Lynn B., Mullis, Ina V.S. *The Reading Report Card, 1971-88: Trends From the Nation's Report Card.* Princeton NJ: Educational Testing Service, January 1990; National Assessment of Educational Progress. *The Reading Report Card, Progress Toward Excellence in our School: Trends in Reading over Four National Assessments, 1971-1984.* Princeton, NJ: Educational Testing Service, 1985; Applebee, Arthur N., Langer, Judith A., et al. *Learning to Read in Our Nation's Schools: Instruction and Achievement in 1988 at Grades 4, 8, and 12.* Princeton, NY: Educational Testing Service, June 1990.

TABLE 12
Changes in Percentile Ranks for Chapter 1 Students in Reading and Mathematics, 1983-84

	Reading		Mathematics	
Grade	Spring 1983: End of School Year Prior to Chapter 1 Participation	Spring 1984: End of School Year Which Included Chapter 1 Participation	Spring 1983: End of School Year Prior to Chapter 1 Participation	Spring 1984: End of School Year Which Included Chapter 1 Participation
2	29	31	35	40
3	24	29	31	37
4	24	29	28	34
5	23	28	28	35
6	23	28	28	35
7	23	27	25	31
8	23	27	28	33
9	23	25	30	32
10	18	20	24	25
11	17	18	25	26
12	16	16	22	25

Source: Kennedy, Mary M., Beatrice F. Birman, and Randy E. Demaline. *The Effectiveness of Chapter 1 Services.* Washington, D.C.: U.S. Department of Education, Office of Educational Research and Improvement, July 1986.

OTHER ANCILLARY SERVICES

Children who are poor or low achievers are not the only students who could benefit from special ancillary services provided through the schools or the community. Developmental delays and learning disabilities are fairly common, and increasing numbers of children experience psychological disorders that absorb their energies and attention, making learning more difficult. In 1988 a total of 20 percent of all children under eighteen were identified by their parents as affected by developmental delay, learning disabilities, or significant emotional problems (Zill and Schoenborn, 1990) (see Table 13, page 36). Over 25 percent of children age twelve to seventeen suffered from one of the three conditions, and nearly 19 percent had significant psychological problems. The portion of children aged three to seventeen who have *received treatment or counseling* for emotional or behavioral problems rose from 6.5 percent in 1981 to 10 percent in 1988. Making counseling services more available and affordable would help large numbers of students. Better access to health care is another important issue for many. Until students are aided in addressing these other areas of need, learning and school work may continue to be a low priority in their lives.

TABLE 13

Percent of Children Who Ever Had a Delay in Growth or Development, a Learning Disability, or an Emotional Problem[a] by Age and Selected Characteristics, 1988

(Percent With Emotional Problem)

	3-17 years old	3-5 years old	6-11 years old	12-17 years old
All children[b]	19.5 (13.4)	9.5 (5.3)	19.1 (12.7)	25.2 (18.5)
Sex				
Male	22.9 (15.4)	10.5 (6.1)	20.3 (15.6)	29.2 (20.4)
Female	16.0 (11.3)	8.5 (4.5)	15.4 (9.8)	20.8 (16.5)
Race				
White	20.7 (14.2)	10.0 (5.6)	20.3 (13.6)	26.7 (19.5)
Black	14.9 (10.3)	5.0 (2.4)	14.8 (9.2)	19.5 (15.1)
Hispanic Origin				
Hispanic	17.2 (12.0)	8.5 (4.5)	19.6 (13.4)	19.2 (14.8)
Non-Hispanic	19.9 (13.6)	9.7 (5.4)	19.1 (12.7)	25.8 (18.9)
Family Income				
<$10,000	22.8 (15.8)	11.5 (4.7)	23.8 (16.2)	28.6 (22.5)
$10,000-$24,999	21.0 (14.5)	10.1 (6.0)	21.3 (15.0)	27.3 (19.3)
$25,000-$39,999	19.5 (13.4)	11.3 (5.9)	17.6 (11.5)	26.0 (19.6)
$40,000 or more	18.6 (12.8)	6.8 (4.8)	18.0 (11.4)	24.1 (17.6)
Place of Residence				
Metro area	19.6 (13.7)	8.5 (5.2)	19.5 (12.9)	25.4 (19.1)
Central city	18.7 (13.6)	8.0 (4.7)	19.2 (13.1)	24.1 (19.1)
Not central city	20.1 (13.8)	8.9 (5.5)	19.6 (12.8)	26.1 (19.1)
Not Metro area	19.4 (12.4)	12.3 (5.5)	17.9 (12.0)	24.6 (16.5)
Assessed Health Status				
Excellent, very good, or good	19.1 (13.1)	8.9 (5.0)	18.7 (12.5)	24.8 (18.1)
Fair or poor	35.3 (23.3)	25.7 (8.4)	35.7 (20.4)	39.3 (31.8)
Mother's Education				
<12 years	20.3 (13.6)	10.2 (5.2)	18.4 (12.3)	26.2 (18.5)
12 years	19.0 (12.5)	11.2 (6.2)	18.8 (11.8)	23.2 (16.7)
>12 years	19.3 (13.7)	7.3 (4.2)	19.4 (13.3)	26.3 (20.1)
Family Structure				
Biological mother & father	14.6 (8.3)	8.1 (4.0)	14.4 (8.0)	19.2 (11.6)
Biological mother & step-father	29.6 (23.6)	14.4 (12.0)	27.0 (19.6)	34.5 (29.1)
Biological mother only[c]	24.8 (19.1)	11.7 (6.6)	24.5 (18.9)	31.4 (25.5)
All other	28.2 (22.2)	13.5 (10.0)	29.7 (22.6)	31.4 (25.8)

[a] That lasted three months or more or required psychological help.

[b] Includes other races and unknown sociodemographic and health characteristics.

[c] Includes families in which the mother lived with the child's grandmother or other adult relative.

Source: Zill N., C.A. Schoenborn. *Developmental Learning and Emotional Problems: Health of our Nation's Children, United States, 1988.* Advance Data from Vital and Health Statistics. Hyattsville, Maryland: National Center for Health Statistics, 1990.

EDUCATION AND NATIONAL ECONOMIC GROWTH

Education improves job performance and raises wages and lifetime incomes for individuals. In the aggregate, these beneficial individual effects mean that education is important for national economic growth and productivity increases. Additionally, education facilitates and promotes technological change, a very important component of economic growth.

Identifying the causes of economic growth has been an area of interest to researchers for centuries. In recent years, with better data collection and analytical tools, economists have been able to quantify the relative contributions to growth of a variety of factors, such as the quality and quantity of labor and capital (plant and equipment), energy, technological change, and others. Repeatedly, education is found to make an enormous contribution to economic growth.

A major investigator in this field is Edward Denison of the Brookings Institution who found that between 1929 and 1982, education was responsible for over 27 percent of all growth in output per worker, and 14 percent of total growth in output of goods and services (Denison, 1985). Actual growth in output per person employed in the U.S. averaged 1.48 percent annually, meaning a doubling of output per person every forty-seven years (see Table 14, page 38). Total output of goods and services grew at an average annual rate of 2.92 during this period, but a large share of this growth was due solely to increased numbers of people and machines working. If we examine growth of output per worker, we see that it increased -- despite a decline in average hours worked -- because of the increased quality and productivity of the labor force due primarily to increases in educational attainment. Comparing the factors responsible for economic growth we find that increases in plant and equipment contributed 20 percent to growth. The largest contribution to growth, responsible for 68 percent of the per worker total, and 35 percent of total growth, was rising productivity, or the ability of the economy to produce more with the same amount of inputs. Most of the productivity increase (64 percent) was due to advances in knowledge. Education plays a particularly important, but unmeasurable, role here as well.

Another technique of analysis examines growth in each industry and then aggregates the findings to the economy as a whole. Researchers using this method find an average annual growth rate of 3.4 percent between 1948 and 1979. Again, much of this growth is simply due to increases in the numbers of people working and in the amounts of equipment and raw materials used. Increases in the education of workers was responsible for 7 percent of this total (Jorgenson et al., 1987) (see Table 15, page 39). (For this same period, 1948-1979, Denison found education responsible for 12 percent of total growth. See Table 14.) If the educational achievement of the labor force had not increased between 1948 and 1979, then in 1979, national income would have been from 8 to 13 percent lower, or down $1,489-2,424 per person in 1990 dollars.

Both of the studies just discussed use workers' years of education as an indirect measure of actual academic achievement and ability. This assumes that a student learned the same amount during a year's education in 1929 as in 1979. But others, particularly John Bishop of Cornell University, have questioned this assumption, arguing that it is not the number of years in school that matters, but the actual intellectual gains made. And if the quality of schooling or the amount students learn during a year in school were to

TABLE 14
Sources of Economic Growth, 1929-82,
Average Annual Growth Rates in Percentage Points
(as a percentage of national income growth)

	Growth in Output per Person Employed	Total Growth in Output	
	1929-1982	*1929-1982*	*1948-1979*
National income	1.48 (100)	2.92 (100)	3.47 (100)
Labor, Capital and Land	0.47 (32)	1.90 (65)	2.22 (64)
Labor	0.22 (15)	1.34 (46)	1.45 (42)
Employment	--	1.12 (38)	1.32 (38)
Hours	-0.27 (-18)	-0.27 (-9)	-0.28 (-8)
Other quality changes	0.09 (6)	0.09 (3)	-0.02 (-1)
Education	0.40 (27)	0.40 (14)	0.41 (12)
Capital	0.30 (20)	0.56 (19)	0.77 (22)
Land	-0.05 (-3)	0.00 (0)	0.00 (0)
Output per unit of input	1.01 (68)	1.02 (35)	1.17 (34)
Advances in knowledge	0.65 (44)	0.66 (23)	0.88 (25)
Improved resource allocation	0.23 (16)	0.23 (8)	0.24 (7)
Economies of scale	0.26 (18)	0.26 (9)	0.31 (9)
Other	-0.13 (-9)	-0.13 (-5)	-0.21 (-6)

Source: Denison, Edward F. *Trends in American Economic Growth, 1929-1982.* Washington, DC: The Brookings Institution, 1985.

change, then a given number of years in school would not always correlate with a constant level of intellectual achievement.

This is relevant for the U.S. economy because in the mid-to-late 1960s, student achievement as measured by a variety of standardized tests, such as the Scholastic Aptitude Test (SAT), began declining, and this trend was not reversed until the late 1970s. If it is workers' actual intellectual achievement, and not just years in school, that affects economic growth, then we would expect that this decline in achievement would have a negative impact on economic growth. Bishop (1989a) estimates these achievement declines reduced national income by 0.9 percent in 1980 ($25 billion in 1980 dollars), by 1.9 percent in 1987 ($86 billion in 1987 dollars), and that by the year 2000, the reduction will be 3.6 percent or approximately $342 billion in 2000 dollars. Put another way, if test scores and student

TABLE 15
Sources of Total Economic Growth, 1948-79
Average Annual Growth Rates in Percentage Points
(as a percentage of total economic growth)

Economic growth[a]	3.42	*(100)*
Labor and Capital	2.61	*(76)*
Labor	1.05	*(31)*
Hours	0.68	*(20)*
Education	0.24	*(7)*
Other changes in labor quality	0.13	*(4)*
Capital	1.56	*(46)*
Output per unit of input	0.81	*(24)*

[a] Value-added.

Source: Jorgenson, Dale W., Frank M. Gollop, and Barbara M. Fraumeni. *Productivity and U.S. Economic Growth.* Cambridge: Harvard University Press, 1987.

achievement had continued to follow their historic upward path, national income in 1987 would have been $86 billion greater.

Fortunately, test scores for today's students are rising and in some cases have surpassed their previous highs. But workers who entered the labor force with lower levels of achievement will continue to be a drag on economic growth unless further training or other steps are taken to offset their lower achievement levels.

But some have argued that these accounting methods underestimate the economic contributions of schooling. The productivity benefits of physical capital could not be fully realized without educated workers, and education is a prerequisite for the introduction of technological changes into a workplace (Psacharopoulos cited in Kendricks, 1984). Just as people are more productive with tools, machines and other types of physical capital with which to work, so also is physical capital more productive with educated and skilled workers. Lester Thurow writes "Human capital is of little value without physical capital with which to work, physical capital is of little value without the necessary human skills to operate it efficiently" (cited in Leslie and Brinkman, 1988, p85).

That the education and achievement level of the workforce is important for economic growth is further supported by work which has attempted to explain different economic growth rates among countries. Analyses which omit consideration of "human capital" (i.e., workers' skills and intellectual abilities) do a much poorer job of explaining differences in growth than do analyses which include these factors (Mankiw et al., 1990). Ignoring differences in the abilities of the labor forces of various countries limits our understanding of their differential rates of growth.

Education is important in ways other than simply raising workers' productivity and wages. Increases in earnings account for less than half of the true benefits of education (Jorgenson and Fraumeni, 1989). Just as important are the benefits of education for other activities such as raising a family, enjoying leisure time, and traveling.

But education makes another important contribution. In addition to being a factor which improves workers' skills, it is also a source of technological change and innovation. Although the impact of education on the growth of knowledge and technological change is impossible to quantify precisely, studies by Denison and others suggest it is very large. This benefit of education is not included in the estimates of the gains from education described above, and if it could have been included, the measured benefits of education to the economy would be much greater.

CONCLUSION

It has been argued, and evidence has been presented, that in the past advances in education made major contributions to economic growth. And the implicit conclusion we would like to make based on this evidence is that further increases in educational attainment will bring more economic growth in the future. There are problems with both of these statements. The evidence of past contributions from education must be accepted with some reservations, and we cannot assume that past trends will *automatically* continue into the future.

First, let us review the evidence of past contributions. The economic benefits of education are assumed to result in specialized skills and higher individual productivity which in turn are rewarded with higher wages. But wages may not always reflect productivity, and more educated workers may receive higher wages for reasons unrelated to higher productivity and greater economic contribution.

This means that we cannot attribute to education all the increases in earnings received by more educated people, and advocates for education must be careful not to oversell its economic contributions, both past and future. Studies which do not take into account factors (other than schooling) which influence wages will err in their estimates of the economic effects of education. But is also true that much education does improve workers' skills and abilities in ways which raise productivity. As has been shown, these effects are quite large in total. It is the objective conclusion of the authors of this report that while wages and productivity can diverge for all the reasons mentioned above, education has made a very significant contribution to past economic growth.

But can we assume that further advances in educational attainment will continue to have the same positive effect on economic growth in the future? Education affects economic growth only when workers use their special skills and knowledge in the performance of their jobs. If additional skills are not utilized on the job, there is no stimulus to the economy. In the past, when increases in educational attainment mainly meant that larger numbers of workers were strengthening their basic literacy and numeracy skills, it was easy to understand how these skills would automatically be used to improve job performance.

It is less clear today that, for the average worker, additional education will be utilized on the job. Just 5 percent of employers think that education and skill requirements are increasing significantly (Commission on the Skills of the American Workforce, 1990). This means that 95 percent of employers do not anticipate rising demands for skills and education. But if the U.S. is to be competitive in international markets, we must move toward production techniques that require highly skilled workers to perform competently in more demanding jobs. Workers, jobs, and the way work is organized must all be upgraded if any improvements are to be effective. Many workers will need additional skills before it will be possible to organize work, implement technologies, and structure jobs in ways which will make U.S. production of goods and services more competitive. The availability of highly educated and skilled workers is a prerequisite for the transition to a "high-performance" economy.

But an abundance of well-educated, highly-skilled workers alone will not guarantee that needed changes occur. Education advocates must be careful not to promise more than can be delivered. Education is necessary to *enable* the change to more highly skilled jobs in a more competitive economy, but even an abundance of very educated workers cannot *ensure* that change will occur. For that, additional workplace and industrial policies are necessary to push business and industry onto the high-skill, high-wage path. But better educating our current and future workforce is a necessary part of this process; the transition cannot occur in its absence.

Education has made important contributions to past U.S. economic growth. It has the potential to do so in the future, provided jobs are designed to make full use of workers' skills. An abundance of well-educated workers can promote but not ensure the transformation into a competitive, high-wage, high-growth economy which provides a high living standard for all Americans.

SECTION III: THE ECONOMIC PAYOFFS OF TRAINING

In a changing economic environment, training plays an important role in maintaining the competitiveness of the economic system and in improving individual job performance as measured by productivity, wages, job tenure, and turnover. The failure of business and government to train front-line workers contributes to the polarization of skills and wages. Lack of training or inadequate training may also be part of a larger problem that locks the economy into a low-skill employment trajectory.

Training does not exist in a vacuum. The demand for skills in an economy depends on how work is organized. The promise and potential of information technology to raise productivity, improve quality, and make firms responsive to changing economic opportunities goes largely unrealized if the organization of work is not transformed -- that is, if work continues to be organized along hierarchical command lines and the work of a large number of workers with narrow skills is directed by a small number of better trained workers and college graduates. In this traditional system of work organization -- in which most workers perform routine jobs while decisionmaking, problem solving, and work flow management are centralized in the hands of supervisors and managers -- employers have less need for skilled front-line workers, and less incentive to provide training. Job training is difficult to justify if jobs are not designed to make use of worker skills. Some employers assert that workers lack basic skills and are difficult to train, but many workers complain that the jobs they are assigned to do underutilize their intelligence and abilities.

A modern economy that continues to organize work in outmoded ways may find itself "trapped in a low-skills equilibrium" (Finegold and Soskice, 1988, p. 22) --caught in a situation in which the lack of investment in training and lack of demand for skilled workers are self-reinforcing. Some observers are concerned that the U.S. is in danger of falling into such a trap.

Literacy levels in the U.S. do not compare well with those in other countries. Only 80 percent of young people in the U.S. function at an eighth grade reading level compared with over 90 percent in Japan, Sweden, and West Germany, and over 85 percent in England. Only 60 percent of young Americans can read at the eleventh or twelfth grade level (GAO, 1990).

Judging by the standard of how modern technology *can* be used, many workers have inadequate skills; however, no shortage emerges when we examine how work is organized and technology is *actually* used. A major study by the National Center on Education and the Economy (1990) found that "95 percent of United States companies still cling to old forms of work organization" and concluded "[b]ecause of this, there is not likely to be a skills shortage in the United States" (p. 2). The study found that U.S. businesses rarely worried about vocational skills of job applicants, but were concerned instead with finding workers who are "reliable" and have "a good attitude, a pleasant appearance, a good personality." Similarly, a study of worker training by the Office of Technology Assessment of the U.S. Congress (OTA, 1990) found that despite the publicity given to new workplace practices, new forms of work organization have not yet "penetrated very deeply into U.S. industry" (p. 102). The study cites a survey of 645 large companies in both manufacturing and service industries that found that only 13 percent were using some form of self-managed work group and merely an additional 4 percent planned to move in this direction. In addition, a recent study of the occupational changes projected by the Bureau of Labor Statistics for the year 2000 found that these changes will have only a small effect on skill requirements. Required job skills will increase very slowly between 1988 and 2000; the growth of skills will be just one-third to one-quarter of historical rates (Mishel and Teixeira, 1991).

These findings on the present demand for skills contrast sharply with the high level of general skills and problem solving abilities that will be required of front-line workers if U.S. firms adopt new job design practices and reorganize production to become high performance work organizations. The use of information technologies in both service and manufacturing firms makes possible more flexible production systems in which decisionmaking is decentralized and transferred downward to production, maintenance, clerical, and sales workers who have the authority and the training to carry out their enlarged responsibilities.

Comparisons with our main international competitors (Wever, Kochan, and Berg, 1991; Kelley, 1985; OTA, 1990, Chap. 1) suggest that the competitiveness of the U.S. economy and its ability to provide high wages for U.S. workers depend on a shift by U.S. companies to new job and organizational design practices and on the investments we make as a nation in a well-qualified labor force. A consensus is emerging that the future strength of the U.S. economy is inextricably linked to the education and training we provide to the 70 percent of the U.S. labor force that does not go to college.

Estimates of what the private sector spends on training vary widely. One study of employer-based training, based on data and case studies of individual employers, concluded that firms spent about $30 billion for formal training and between $90 and $180 billion on informal training annually in the mid-1980s (Carnevale and Gainer, 1989). Spending on formal training by U.S. employers amounts to just 1.4 percent of total payroll. Much higher estimates of training expenditures were obtained in a study in which total annual costs of job training were calculated indirectly using information on time spent in training and on wages. This study estimates that total spending by U.S. firms to train and retrain workers was between $148 and $296 billion a year in 1976, or between 5.6 and 11.2 percent of total payroll (Mincer, 1989, pp. 13-14).

This section examines the economic payoffs to these investments in training. The empirical evidence reported below suggests that the payoffs to training are highest when businesses make corresponding *shifts in work organization, job design, and the industrial relations system* (Finegold and Soskice, 1988). Training and skill development cannot be viewed in isolation. The returns to these investments in workers largely depend on "how workers are deployed and skills are utilized by employers" (Kochan and Osterman, 1991; Appelbaum, 1991). We examine in turn the evidence bearing on the outcomes of training for the economy and for the individual. We conclude the discussion of training by considering the importance of public initiatives in enabling the U.S. economy to avoid the low-skills trap and move to a high-skills equilibrium.

TRAINING AND OVERALL ECONOMIC PERFORMANCE

The training of workers, especially the vast majority who perform jobs for which a college degree is not required, has emerged as an issue of major concern in all of the industrialized economies. The basic hypothesis is that training not only raises wages of workers and improves labor market outcomes for individuals, but that there are social returns to investments in training. Society gains when workers are better trained and work is reorganized to use these increased skills.

Two types of studies are available for testing this hypothesis. One approach uses a "production function" to examine how the outputs of the economy are related to inputs. This approach allows investigators to measure the increase in output associated with an increase in skill. The second approach uses matched pairs of firms that produce the same product or service -- in order to observe whether firms in which workers are better trained and in which work is organized to utilize worker skills have superior performance.

> A recent review of available studies (Kochan and Osterman, 1991) found:
> these studies provide rather consistent and convincing evidence that (1) education and training are associated with *significant productivity increases* when their impact is examined in a production function context; and (2) training and associated flexible human resource systems are associated with *higher levels of productivity and quality* in matched comparisons. (pp. 16-17) (emphasis added)

The authors also noted that international comparative studies consistently show that U.S. firms invest less in training and perform more poorly than other firms while Germany provides the most training of the half dozen industrialized nations most often studied and German firms record the best performances (Kochan and Osterman, 1991, pp. 62-65).

Studies which use a production function approach generally count years of formal schooling, including attendance at vocational, commercial, or technical institutes, as a proxy for worker skills. One study of sixty-one U.S. manufacturing industries over a thirty-year period, in which workers with more than a high school degree (skilled workers) are distinguished from those with a high school degree or less (unskilled workers), found that skilled labor is important in technologically progressive industries. This study found that the demand for skilled labor is higher in industries in which technology is newer and R&D intensity is greater (Bartel and Lichtenberg, 1987). Other studies have found that educational levels of workers in an industry are positively related to output (Brown and Medoff, 1978) and have a positive effect on productivity (Daly, 1986).

Studies of matched firms are able to use more direct measures of worker skills and training. Some studies simply compare work organization and worker skills. A comparison of matched manufacturing firms in Britain, France, and Germany found that German firms had a higher proportion of production workers, that these workers could perform a larger number of different tasks, that they required less supervision, and that they received more training (Maurice, Sorge, and Warner, 1980). A comparison of computerized numerical control technology in German and British plants found that German operators did much more programming than British operators. The study found a greater continuum of skill among German workers and a greater polarization between high-skill and low-skill British workers (Hartmann, Nicholas, Sorge, and Warner, 1983).

Other studies examine the effects of differences in skill and work organization on plant productivity and quality. A comparison of flexible manufacturing systems in the U.S. and Japan found that Japanese machine operators had substantially higher skill levels than U.S. operators. Japanese firms produced both a higher volume of parts and more different parts per machine (Jaikumar, 1986). An international study of automobile assembly plants found that worker involvement and participation are positively associated with productivity and quality; and that high-quality, high-productivity firms also provide workers with more training (Krafcik and McDuffie, forthcoming, cited in Kochan and Osterman, 1991). A comparison of British and German manufacturing plants found the German firms to be more productive. This resulted from the greater ability of German workers to maintain machinery which, in turn, was related to higher levels of training (Steedman and Wagner, 1989). Similarly, a study of matched British and German plants in six industries found the German plants to be more productive and attributed this to the broader training given to German foremen, who are responsible for maintenance, quality control, and production planning (Daly, Hitchens, and Wagner, 1985). Finally, a study of several plants of a single firm compared operations in the U.S., Italy, and Germany. The study found that start-up time was longer and operating improvements smaller in plants in the U.S. and attributed this in part to less development and cross-training of workers (Tyre, 1990).

The low commitment of U.S. firms to investment in training and to the transformation of work organization appears to be manifest even in high technology industries. Case studies of plants belonging to eight large firms in high technology industries found that:

> [h]uman resource policies were informally ranked as low in influence relative to finance, R&D, and marketing; employee participation or work teams are encouraged in only three of the eight cases and even in these firms only a minority of employees work in teams or are involved in participation programs (Kochan and Osterman, 1991, p. 43).

The researchers found wide variations in the amount of training provided, with two firms deeply committed to training and the other six firms uninterested or providing only minimal exposure. Taking all of the firms together the study concluded that:

> if the policies observed in this small sample are representative of high technology firms in the U.S., it is unlikely that the country can count on sustaining a competitive advantage in this sector because of the quality of our workforce or our human resource practices. (p. 45)

TRAINING AND INDIVIDUAL OUTCOMES

Empirical investigations offer important insights into the effects of training on individual workers. The most widely studied issue is the effect of training by an employer on an individual's wages. The results here are unambiguous: all studies find that workers' wages grow more quickly when they receive employer-provided training (Rosen, 1982; Lillard and Tan, 1986; Mincer, 1988; Holzer, 1988; Brown, 1988; Barron, Black, and Loewenstein, 1989; Lynch, 1989; Flynn, 1990). The exact magnitude of the increase in wages varies, depending on the characteristics of the sample and on the type and intensity of the training. Summarizing the results of several of these studies, Jacob Mincer (1989) concluded that:

> In sum, estimated effects in terms of earnings received of an additional year with training appear to range from 4.4 percent in the PSID [Panel Study of Income Dynamics] for all new hires, 9 percent for young workers in the PSID [Panel Study of Income Dynamics], 7 percent for the new youth cohort in the NLS [National Longitudinal Samples], and 11 percent for the previous youth cohort in the NLS. (p. 8)

Similar results were obtained in a study utilizing the Survey of Income and Program Participation (SIPP) data, where training provided by the current employer increased wages 10 percent. The combination of training received in a previous job and training received on the current job increased wages 23 percent (Flynn, 1990). This study also found that training outside the firm -- business, commercial, or vocational training -- raised wages 4.1 percent and that apprenticeships had a positive but not significant effect on wages.

One of the more interesting data sets is the Equal Opportunity Pilot Project (EOPP). While other data sets are based on surveys of individuals or households, this one is based on a survey of employers. The firms in this sample include a large number of big and/or low- wage firms and are heavily concentrated in the South and Midwest. Holzer (1988) reports that the relatively low- wage nature of the sample is reflected in an average wage for new hires of about $5.00 an hour -- about one-half the average manufacturing wage in 1980-81. Most workers are high school graduates employed in clerical, sales, and service occupations; and women as well as men received training in these firms. The sample primarily captured young workers early in their careers. Studies using this data set (Holzer, 1988; Barron, Black, and Loewenstein, 1989) found that formal training provided by employers had a significant, positive effect on both current wages and wage growth in the first two years of employment for these young workers. Barron et al. found that an increase of 10 percent in training raised wage growth by 1.5 percent (1989, p.7).

Tables 16, 17, and 18 clarify the effects of training on wages in the early 1980s for three different samples of employees. Table 16 examines separately the effects on hourly wages of young workers (average work experience 3.7 years) of six months of training in a vocational, technical, or business school; six months of on-the-job training with the current

TABLE 16
EFFECT OF TRAINING ON PREDICTED HOURLY WAGE
National Longitudinal Sample (NLS) Youth Survey, 1983

White male, average characteristics[a]	
no training	5.88
6 months off-the-job training	6.19
6 months OJT, current employer	6.69
1 additional year of schooling	6.13
Nonwhite male, average characteristics[a]	
no training	5.43
6 months off-the-job training	5.71
6 months OJT, current employer	6.17
1 additional year of schooling	5.65
White female, average characteristics[a]	
no training	4.99
6 months off-the-job training	5.24
6 months OJT, current employer	5.66
1 additional year of schooling	5.19
Nonwhite female, average characteristics[a]	
no training	4.60
6 months off-the-job training	4.84
6 months OJT, current employer	5.23
1 additional year of schooling	4.79

Total number in sample is 3,183

[a] Average characteristics for the sample. Includes characteristics such as education, work experience, health unionization.

Source: Lisa M. Lynch. "Private Sector Training and Its Impact on the Earnings of Young Workers." National Bureau of Economic Research, Working Paper No. 2872. Cambridge, MA: NBER, 1989, Table 5.

employer; or one additional year of schooling. The largest increase in wages occurs as a result of six months of on-the-job training. For white males, the increase amounts to 81 cents an hour; for nonwhite males it is 74 cents an hour; for white females, 67 cents an hour; and for nonwhite females, 63 cents an hour. These increases are larger even than the rise in wages associated with an additional year of schooling. Table 17 examines the effect of employer-provided training on the hourly wages of newly-hired adult workers (average work experience 8.7 years). New hires in this sample received on average a little less than ten hours of formal training and eighty hours of informal training and training by coworkers. Training raised the wages of these workers about a nickel an hour. About a third of the newly-hired workers received fifty or more hours of formal training and 280 hours of informal and coworker training. For men, this raised hourly wages about 20 cents an hour; for women, about 16 cents an hour. Finally, Table 18 examines the percentage

TABLE 17
EFFECT OF TRAINING ON PREDICTED HOURLY WAGE
Employment Opportunity Pilot Project (EOPP), 1982

Male, new hire, average characteristics[a]	
no training with new employer	$5.14
10 hours formal training	5.17
80 hours informal coworker training	5.16
90 hours total training	5.19
50 hours formal training	5.26
280 hours informal/coworker training	5.22
330 hours total training	5.34
Female, new hire, average characteristics[a]	
no training with new employer	$4.79
10 hours formal training	4.81
80 hours informal coworker training	4.81
90 hours total training	4.83
50 hours formal training	4.89
280 hours informal/training	4.85
330 hours total training	4.95

Total number in sample is 1,320

[a] Average characteristics for the sample. Includes characteristics such as education, work experience, health, unionization.

Source: Author's estimates based on data in Holzer, 1988

increase in monthly earnings of adult workers (average work experience 8.2 years) attributable to having received training in a vocational, technical, or business school; in an apprenticeship program; or from current, previous, or both employers. Employer-provided training has the largest effect on monthly earnings. On-the-job training from the current employer raised wages 9.7 percent; receiving such training from both the current and previous employer raised wages 22.8 percent.

The Equal Opportunity Pilot Project surveys include data on employee productivity as well as wages. Results of the Barron et al. study "indicate that on-the-job training is a primary factor affecting wage and productivity growth" (1989, p. 16). The researchers found that a 10 percent increase in training is associated with a 3 percent increase in productivity growth, or that the productivity increase is twice as large as the wage increase caused by training. Holzer (1988) found that training increases both current productivity of workers and productivity growth over a two-year period. Interestingly, this study found that "female

TABLE 18
EFFECT OF TRAINING ON PREDICTED MONTHLY WAGE
Survey of Income and Program Participation (SIPP), 1984

Person with average characteristics[a]	Percent increase in income compared to pèrson with no training
received off-the-job training	4.1%
received OJT, current employer	9.7
received OJT, previous employer	4.5
received OJT, both employers	22.8
apprenticeship	6.0

Total number is sample is 20,970

[a] Average characteristics for the sample. Includes characteristics such as education, work experience, health, unionization.

Source: Flynn, 1990, Table A.

employees show significantly higher productivity growth than do males, though there is no significant growth in their relative [to males] wages" (p. 14).

Other studies of the relationship between training and productivity of individual workers found similar results (Blakemore and Hoffman, 1988; Flynn, 1991; Bishop, 1988c). One study found that productivity grew four to five times faster than compensation during a worker's first two years on the job (Bishop, 1988c).

Results such as these led Jacob Mincer (1989) to conclude that training is a highly profitable investment for firms. Even after correcting the rate of return to firms on investments in training (1) for any depreciation over time in worker skills, and (2) for the higher mobility of young workers, Mincer still found that investments in training are profitable for firms. He concludes that, in general, "risks of capital loss resulting from worker separations would not produce a strong deterrent to investment in training by firms. . ." (1989, p. 11). The high rates of return to investments in training suggests that the U.S. economy underinvests in employer-based training.

The increase in wages associated with training has two other favorable effects on individuals. By raising wages, training increases the attachment of workers to the firm and reduces turnover. Mincer (1988) found positive effects of training on wage growth and negative effects on turnover over periods of seven or more years. The negative relationship between the rate of change of wages and labor turnover holds across industrial sectors in the U.S. (Mincer and Higuchi, 1988). As a corollary of the reduced turnover, Mincer found that another effect of job training was a reduction in the incidence of unemployment among workers who receive training. Since nearly half of firm separations result in unemployment, training reduces the risk of unemployment by reducing turnover.

WHO DO EMPLOYERS TRAIN?

Evidence on who gets training by employers and on the relationship between schooling and training that emerges from these empirical studies casts an interesting light on the question of whether training raises wages because it raises worker productivity or simply functions as one more screening device that enables firms to select for employment workers with other characteristics that they prefer for higher paying jobs. Most of the studies cited above find a strong link between schooling and participation in employer-provided training. The exception is Lisa Lynch (1989, p.22) who found that "[s]chooling raises the probability of receiving off-the-job training and apprenticeships but it has no impact on the probability of receiving firm provided, on-the-job training."

The study by Flynn illuminates what is at work. Using a very large data set that includes detailed information about the individual's high school program and the courses actually taken, she finds that "learning ability, as reflected in the courses taken in high school, significantly drives earnings; is correlated with schooling attainment; and is uncorrelated with training" (1990, p. 16). She concludes that education acts as a screening device used by employers to sort workers into jobs that require training, but that differences in "learning ability" do not translate into corresponding differences in being able to benefit from training. Flynn finds that how much the productivity and wages of an individual worker improve as a result of employer-provided training is not related to achievement in high school.

Education is not the only sorting device used by employers in deciding who gets training. Gender and race also play an important role. Lynch (1989, p. 13) finds that "company provided on-the-job training is concentrated among white, married, unionized males with greater work experience" and that women and nonwhites are much less likely to receive such training. She concludes, "the characteristics that appear to influence the probability of receiving training are primarily race and sex" (p. 21). Yet, the evidence shows that training is effective in raising wages and productivity for women and nonwhites when they receive it. Lynch found that a nonwhite male who obtains off-the-job training can almost completely eliminate the wage gap between himself and a white male with no training. And, as indicated earlier, Holzer (1988) found that training raised the productivity of women more than that of men, though not their wages.

The conclusion to be drawn from these studies is that the increase in wages associated with employer-provided training is not simply a "credentials effect," in which workers who have received training are better positioned in the job queue regardless of whether their skills are relevant to the jobs they do. While this may be one avenue through which training operates to raise wages, the evidence reviewed here demonstrates that employer-provided training raises the wages of individual workers because it raises their productivity. However, the view that workers are able to choose to invest in their futures by seeking jobs that provide training, even if (as is usually the case) these jobs pay lower initial wages, does not hold. It appears, instead, that firms hire workers into jobs that provide training on the basis of their gender and race. Schooling is also used as a screening device that enables firms to select certain workers for training.

THE PUBLIC INTEREST IN PRIVATE TRAINING

Enterprise-based training plays an important role in preparing workers to do their jobs in all industrialized countries. Workplace training takes many forms including formal and informal on-the-job training; training in schools or vocational institutions that includes a work-based component; and apprenticeship programs. This makes it difficult to compare the amount of employer-provided training across countries (Lynch, 1991). Nevertheless, such comparisons do provide information on how well the U.S. is doing relative to its main competitors. Table 19 (page 52) reports rough measures of the percent of individuals who received enterprise-related training in the U.S. and six other industrialized countries in 1990. Only 12 percent of all workers in the U.S. received such training. As can be seen in Table 19, a U.S. worker is much less likely to participate in enterprise-related training than is a worker in Sweden, Japan, or Australia, where participation rates were two to three times higher. U.S. workers overall were about as likely as those in West Germany or Great Britain to receive such training, and more likely than those in France. However, in West Germany and France very high proportions of young people participated in such training -- 76 percent of fifteen to nineteen year olds in West Germany and 43 percent in France. In comparison, only about 3 percent of noncollege-bound youths enter an apprenticeship in the U.S. (Lynch, 1991, p.9) and only 4 percent of young workers who are not university graduates get formal training at work (Lynch, 1991, p. 10). Of course, young people in the U.S. are more likely to receive post-secondary schooling than their counterparts in most other countries except for France. More than 20 percent of young people in the U.S. and France are enrolled in post-secondary schools that do not offer a bachelor's degree, compared with 13 percent in England, 11 percent in Sweden, 6 percent in Japan, and 4 percent in West Germany (Lynch, 1991, Table 2). Also complicating the interpretation of these economy-wide comparisons is information on the content of workplace training that is available from investigations of particular industries. A study of training in the nuclear power industry, for example, found that half of U.S. training in this industry is in "fundamentals," while no time is spent on this in Europe. Given the higher initial level of preparedness of European workers, more time is spent on advanced topics (Mason, 1990, cited in Lynch, 1991).

TABLE 19
Enterprise Related Training (1990), Percent of Individuals Receiving Training

Country	
United States	11.8% all workers (Current Population Survey, Formal Training)
West Germany	12.7% all workers 76% 15-17 years old
Great Britain	14.4% all workers
France	4.6% all workers 43% 15-19 years old 26.6% employees in firms 10+
Sweden	25.4% all workers
Japan	36.7% (within last 2 years)
Australia	34.9% (in-house)

Source: *Employment Outlook*, OECD, July 1991. Taken from Lynch, 1991, Table 3.

Thus, many European employers provide training for young workers through apprenticeship programs that include school as well as work-based components, while Japanese workers receive training through more informal training systems that are nevertheless deeply embedded in the culture of individual firms (Ergas, 1987). In the U.S., though there is greater reliance on formal post-secondary schooling, much training is employer-provided as well. It appears, however, that in comparison with much of Europe and Japan, U.S. firms are doing an inadequate job of training workers, especially those who are not college graduates (Pines and Carnevale, 1991, p. 257). It has been estimated that German employers spent more than twice as much on worker training in 1984 as American firms -- $633 per worker compared with $263 (Hilton, 1991). With U.S. employers currently spending just 1.4 percent of their payroll on formal training, only 10 to 12 percent of all employees are estimated to receive such training in any year (Pines and Carnevale, 1991, p. 264; Lynch, 1991, Table 3). Data from the National Longitudinal Samples cohort of young workers also support this estimate. Only a quarter of the sample of 12,686 youths had received any training between 1978 and 1983. Most young people (15 percent of the total sample) received off-the-job training in barber or beauty schools, vocational and technical institutes, nursing programs, and so on; only 10 percent had participated in on-the-job training programs or apprenticeships (Lynch, 1989, pp. 12, 13).

This tendency for profit-maximizing firms to underinvest in training is consistent with the predictions of economic theory. Worker skills, especially the broad skills needed by firms that adopt more flexible work organizations, are difficult for the firm providing the training to appropriate. Trained workers can be hired away by other firms that fail to provide training and, instead, purchase the skills they need by hiring workers who have been trained by other employers. Thus, firms cannot be certain of recouping investments in their workers, and may find that their investment in training has simply increased the pool of skills available to their competitors. Under these circumstances, firms will be tempted to restrict the amount of training they provide to their workers, and to limit training to job- or firm-specific skills that are not easily transferable (Finegold and Soskice, 1988). High performance work organizations rely on worker skills to increase the range and quality of products and services they provide and to adapt swiftly to later generations of technology. But there are strong incentives for the level of investment in such skills by profit-maximizing firms to be suboptimal.

The Japanese solution to this problem -- restricting the mobility of workers, especially skilled workers -- is neither possible nor desirable in the United States. However, the European solution -- a greater reliance on public-private partnerships in setting occupational training standards, overseeing firm-based training, and sharing the cost of training and retraining workers -- might make sense here.

Access to employer-provided training is another issue in which there is a strong public interest. As firm-based training is currently administered in the U.S., employers have sole responsibility for selection of the training participants and for administration of these training programs. One result is that front-line workers receive much less than their proportionate share of training. As the studies cited above show, the probability of receiving employer-provided training increases with the amount of formal education a worker has. The Census Bureau's Survey of Participation in Adult Education found that 58 percent of employer-provided training went to workers in executive, managerial, professional, and technical positions. However, these workers account for only 27 percent of employees (Carnevale and Goldstein, 1990, p. 49). Similarly, race and gender appear to be important determinants of who receives such training, with many studies finding white males disproportionately likely to be selected to participate (Lynch, 1989). These findings were confirmed in an analysis of 44,388 individuals included in the 1983 Current Population Survey. This study found that the probability of receiving training by an employer was significantly higher for men than for women, for whites than for nonwhites, for those who are more highly educated, and for professionals and managers (Kochan and Osterman, 1991, Table 6).

Women are disadvantaged with respect to training in various ways. Some studies find that the overall *incidence* of training is about the same for women as men but that the duration and the likelihood that it is employer-provided differs. Others find that women are less likely than men to participate. In the Survey of Income and Program Participation study of adults aged sixteen to sixty-four, the average length of all training programs for men and women were about the same, 15.8 weeks for women and 14.8 weeks for men. However, women were somewhat less likely to participate in training. The survey found that 22.4 percent of women had received some sort of training, compared with 25.9 percent of men. In addition, women were much more likely to have paid for their own training than were men --24.1 percent of women as compared to only 16.1 percent of men. The entire difference in the incidence of training among men and women in this study is due to the difference in work-based training. Among women, 10.3 percent had participated either in employer-provided or in apprenticeship training programs, while among men the figure was 13.8 percent (Flynn, 1990, Tables 1 and 2). In the National Longitudinal Samples survey of young workers, women were both less likely to receive training, and received less training even when they participated. The duration of firm-based training for women was just 70 percent that for men (Lynch, 1989, Table 2).

CONCLUSION

Firm-based training is one of the largest sources of training in the U.S. economy, and the most effective. The studies cited above all found that employer-provided training had the largest effect in increasing earnings -- larger than vocational and technical institutes or other forms of off-the-job training. Employer-provided training also reduces turnover and unemployment. Thus, access to training has an important influence on labor market outcomes for individual workers. In addition, women and minorities will make up two-thirds of new entrants to the U.S. labor force between now and the year 2000 (Mishel and Teixeira, 1991). If U.S. firms are to be organized as high performance work organizations, these workers will have to be guaranteed access to the most important type of training. Comparisons of matched firms find that such high performance work organizations consistently outperform firms with less skilled workers and more traditional work organizations in the vital areas of productivity and quality.

SECTION IV: CONCLUSION: MAKING THE INVESTMENT IN LEARNING

A well-educated and highly trained labor force is a prerequisite for a high performance, high wage, economy able to meet the challenges of increasingly competitive world markets. Education has made significant contributions to U.S. economic growth and prosperity in the past, and its importance in the future will be even greater. Money spent wisely getting children ready for school and on education and training programs brings future financial benefits for individuals and for society. Enhancing future returns by raising worker productivity through additional education and training is an important reason to increase the U.S. investment in learning.

The evidence for the importance of learning is overwhelming and incontrovertible. Education makes a major contribution to national economic growth. A well-educated labor force is even more necessary when technology is changing rapidly. There is a demonstrated shortage of college-educated workers. Each additional year of education raises productivity, as reflected in wage increases of 5 to 7 percent per additional year of schooling. Education improves workers' job performance, and makes future training easier and more successful. Training raises workers' productivity and increases wages from 5 to 10 percent. Our young people, and front-line workers in particular, receive inadequate training compared to their counterparts abroad.

There are huge cost savings to be realized by providing the services that ensure all children start school ready to learn. Comprehensive prenatal care for high-risk women would save from $2-3.30 for every dollar spent. The WIC program which provides supplemental food to pregnant women similarly would save $2-3 for every dollar expended. Head Start and other early childhood education programs save approximately $2.48 per dollar spent. There are also savings to be gained by immunizing all children and by increasing lead screening.

Investments in the physical, mental and emotional health of children, in the education and training of young people, and in life-time learning return large financial gains. But as with most investments, the returns do not appear immediately. We must adopt a long term view and be patient. In a global economy, U.S. performance lies in the skills and creative abilities of our workforce. We cannot afford to waste the talents of anyone. Investing in our nation's human resources is a necessary first step in building a competitive, high-performance economy for the 21st century.

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